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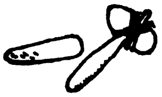
THE GRAPHIC ARTS

Industrial Arts Education Series



THE GRAPHIC ARTS

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FOREWORD

The graphic arts as a significant part of our modern industrial world are making a contribution to our present and future civilization. The young people of today should learn about the graphic arts as a part of their general education and as a possible future vocation or avocation. A clear picture of the graphic arts and their products not only adds interest to living but also improves consumer appreciation for the products of this great industry.

This volume, one of a series on industrial arts education, is a pupil text intended to introduce youth to the field of the graphic arts. Although it is designed for the junior high school grades, it can be used equally well in any of the senior high school grades. It may be used for one of the instructional areas in an industrial arts laboratory or as a text in courses devoted exclusively to the graphic arts. The text has been checked for reading level and supplemented with informative drawings and photographs. Many of the photographs are from industry, but a considerable number show pupils at work in graphic arts courses.

The content of *The Graphic Arts* is based on an extensive study of industry, courses from progressive school systems, the American Vocational Association report on standards in industrial arts teaching, and research studies conducted under the direction of the authors during the past ten years.

The authors wish to thank the many educators in the American public schools who have contributed directly or indirectly to this industrial arts series. While it is not possible to name all the leaders in industrial arts and vocational education who have influenced the authors' thinking during this ten-year undertaking, the following deserve special mention: Earl L. Bedell, Director Vocational Education, Detroit, Michigan; Elmer Christy, Director Industrial Arts, Cincinnati, Ohio; H. H. Hargett, Supervisor Manual Training, St. Louis, Missouri; Coleman Hewitt, Industrial Arts Department, Chicago Teachers College, Chicago, Illinois; Melvin S. Lewis, Indiana University, Bloomington, Indiana; Arthur B. Mays, University of Illinois, Urbana, Illinois; John J. Metz, Editor *Industrial Arts and Vocational Education Magazine*, Milwaukee, Wisconsin; Frank C. Moore, Director Industrial Arts, Cleveland, Ohio; George E. Myers, University of Michigan, Ann Arbor, Michigan; C. E. Nihart, Supervisor Manual Arts, Los Angeles, California; Milo T. Oakland, Head Industrial Arts, Northern Illinois State Teachers College, DeKalb, Illinois; Harold G. Palmer, Head Industrial Arts Department, State Teachers College, Cedar Falls, Iowa; Vern L. Pickens, Director Practical Arts, Kansas City, Missouri; Homer J. Smith, University of Minnesota, Minneapolis, Minnesota; Heber A. Sotzin, Head Industrial Arts Department, San Jose State College, San Jose, California; Roy R. VanDuzee, Director Vocational Education, West Allis, Wisconsin; and William E. Warner, Ohio State University, Columbus, Ohio.

The authors are indebted to the industrial arts teachers of the Chicago schools for suggestions on the content and organization of this text. Harold C. Achtenhagen, Raymond B. Grashoff, and George I. Wilson of the Chicago schools have made outstanding con-

tributions in the development of instructional materials for the graphic arts.

The authors wish to thank the following for their co-operation in furnishing photographs and materials from industry: *The American Printer*, New York; American Type Founders Sales Corporation, Elizabeth, New Jersey; Buckley, Dement and Company, Chicago, Illinois; The Champion Paper and Fibre Company, Hamilton, Ohio; The Chandler & Price Company, Cleveland, Ohio; *Chicago Tribune*, Chicago, Illinois; The Conde Nast Press, Greenwich, Connecticut; W. B. Conkey Company, Hammond, Indiana; Cuneo Press, Chicago, Illinois; the Goss Printing Press Company, Chicago, Illinois; Harris Seybold Potter Company, Cleveland, Ohio; Howard Publishing Company, Chicago, Illinois; Kable Brothers, Mount Morris, Illinois; Mergenthaler Linotype Company, Brooklyn, New York; Miehle Printing Press & Manufacturing Company, Chicago, Illinois; Port Huron Sulphite and Paper Company, Port Huron, Michigan; Rising Paper Company, Housatonic, Massachusetts; and United States Department of Labor, Washington, D. C.

WILLIAM H. JOHNSON
LOUIS V. NEWKIRK

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CHAPTER I

GRAPHIC ARTS IN MODERN INDUSTRY

Graphic arts include some of the world's most important industries, for through this channel comes much of our information. By means of newspapers, magazines, and books—from words and drawings—we learn what others are doing and thinking in all parts of the world. It has been said that the graphic arts industries rank about sixth in output when measured in dollars and cents but rank first or second when their value to civilization is considered.

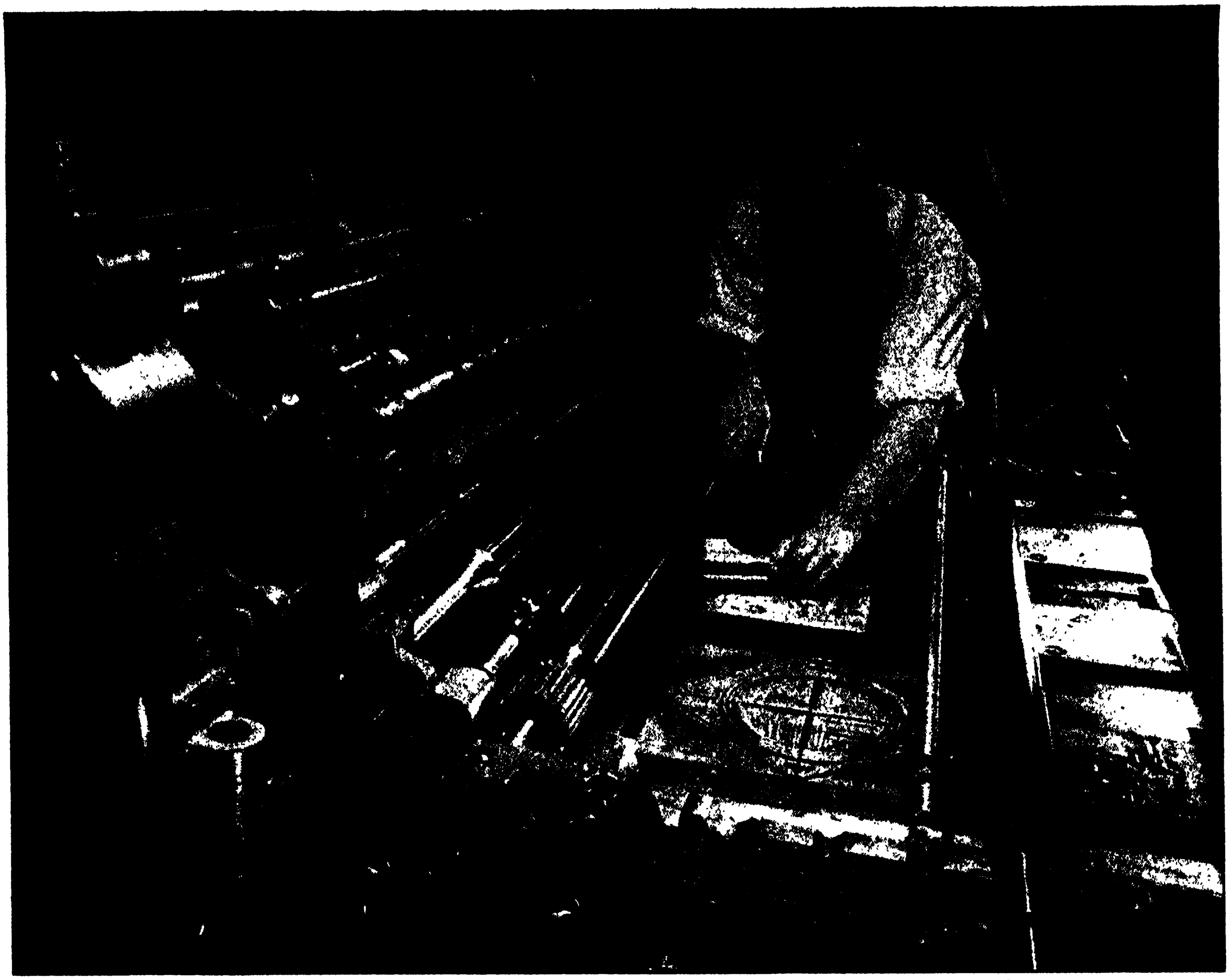
Graphic arts is the term given the lines, symbols, drawings, paintings, and marks upon surfaces by which man expresses his thoughts. The work of the artist is certainly a part of graphic arts; and the taking and the printing of pictures belong also to this field. Perhaps the largest and most active sections of the graphic arts are in the printing industry.

Industry finds the graphic arts vital to its existence. Office and factory forms, catalogs, and sales tickets have long been needed. In addition, many businesses now employ artists to make pleasing drawings of their wares so that the public will notice and purchase them. The photographer and engraver reproduce the artist's drawing for the printing press. Without the graphic arts industry would have a more difficult task in selling its products or services.

The divisions of the graphic arts industry are printing, etching, engraving, electrotyping, stereotyping, photography, bookbinding, and drawing. Because printing uses the products of all the other divisions, we shall discuss it first.

Printing is a broad term covering many operations. Therefore it is considered as including three distinct types of work: *composition*, or typesetting; *presswork*, or actually printing on material such as paper or wood; and *binding*, which is assembling and putting covers on books, making pads, ruling, and gluing tablets.

Composition, setting the type for printing, is divided into two kinds, hand and machine. Setting type by hand is an extremely slow process. Each letter has to be picked up separately and placed in a small metal tray that the printer calls a *composing stick*. When the words and sentences are assembled into eight to twelve lines of type, the type is stored in a larger metal tray called a *galley*. This work is both slow and exacting. Just as exacting but more rapid is the setting of type by machine. There are several machines that set type; perhaps the one used most frequently is the linotype. It is a large machine with a keyboard similar to that of a typewriter. The linotype produces the words on a strip of type metal ready for printing. The type, either hand-set or machine-set, is assem-



Courtesy Miehle Company

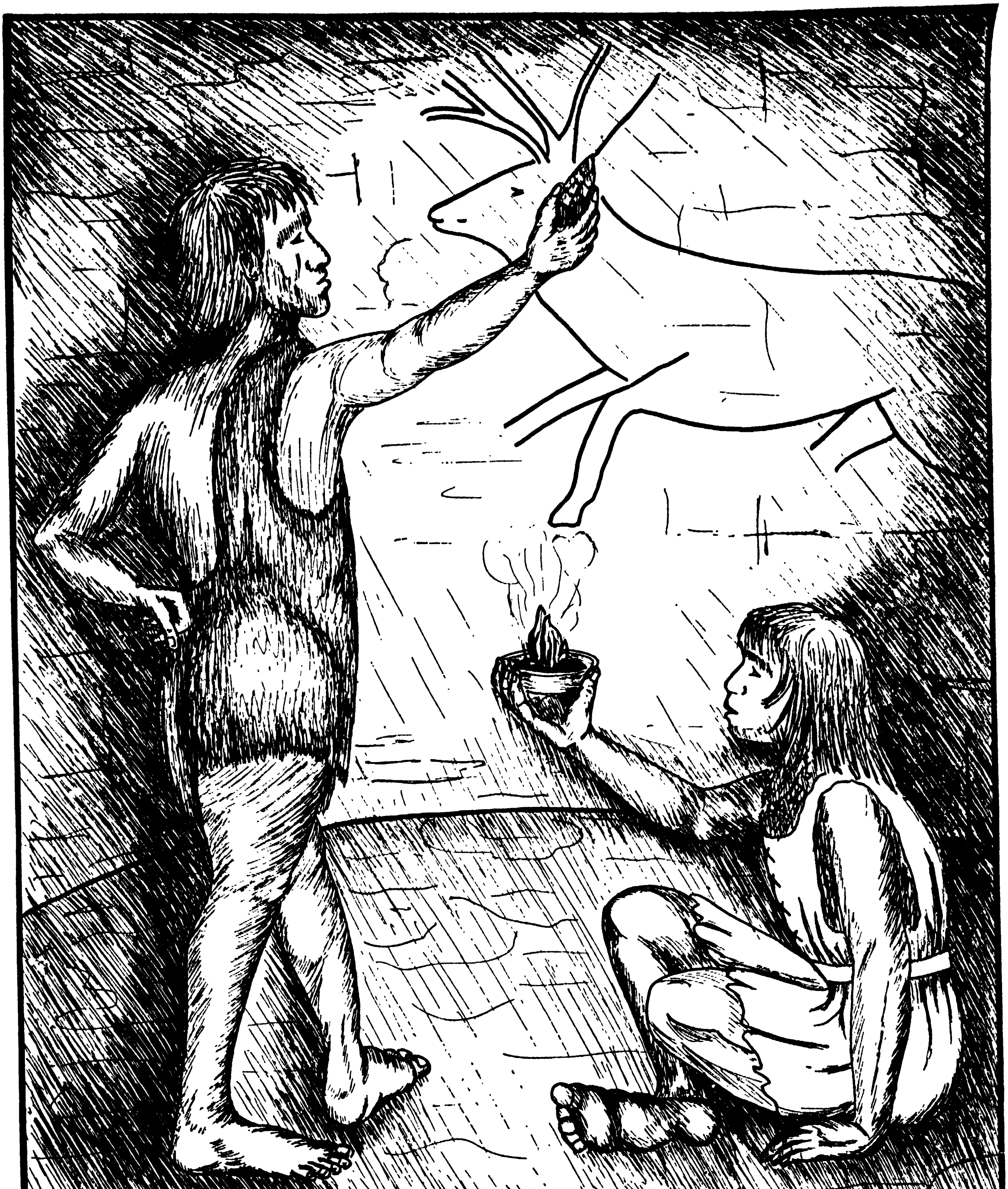
READY TO START THE RUN ON A CYLINDER PRESS

bled in the proper order and locked into a large iron frame called a *chase*. This chase is then placed in the press for printing.

Small jobs are often printed on a Gordon press. This is the press usually found in commercial and school shops and is discussed in Chapter III. Cylinder presses are larger and more complicated. Modern industry uses them because they are able to produce the tremendous amount of printed matter used today. They can print about 2500 sheets an hour. In larger cities printing companies own a dozen or more such machines and have them in operation day and night because great speed in producing the job for the customer is necessary.

Most cylinder presses are completely automatic. The pressman, or operator, places the sheets of paper to be printed on a table at the back of the press. A touch of a button starts the press. The pressman touches another device, and the paper is automatically fed into the press, printed, and delivered onto the receiving table. The machine even counts the number of sheets printed.

The rotary press is a large machine capable of printing at a tremendous rate of speed. It is really a number of presses in a row, arranged so that one, two, three, or more can be operated together. Huge rolls of paper are fed in an almost endless ribbon



into the presses. The rotary prints on both surfaces of the paper at once and is capable of making up to 52,000 copies an hour.

Knowledge and application of the graphic arts have always been important. As far back as we can trace the story of man, we find the crude forms of his efforts to tell the story of his life. Tens of thousands of years ago primitive people scratched, chipped, or drew their stories upon the walls of the caves in which they lived. These pictures are man's first attempts to express himself with lines, symbols, and marks.

As time passed, man learned to cut his messages on slabs of stone that could be carried from place to place. Later clay was used, and the characters were pressed into the soft tablets. Afterward it was found that baking the tablets hardened and preserved them. Many centuries later man learned to tan animal skins and use them as writing surfaces. Such skins are used today for fine work, such as testimonials and some diplomas. The skin is called *parchment*, and sometimes it is used in making lamp shades. Still later the Egyptians found how to use thin strips of the stalk of the papyrus plant to form a sort of crude paper on which they told their story. At an even earlier time the Chinese had learned to make paper on which they could keep their records.

During the Middle Ages man's story was written on either skins or paper by the monks. In their monasteries they worked in groups. One monk would read a few words while the rest wrote these words. Of course, this was extremely slow and mistakes were often made.

In 1417 a man in Antwerp, Lourens Koster, began to carve pictures on wooden blocks, ink these blocks, and press paper over them to secure prints. Later he carved words in wooden plates and printed from these. Although this was a very slow process, each sheet printed from the plate was exactly the same, and there were fewer chances for mistakes.

In Germany an inventive fellow named Johannes Gutenberg used iron in making hollow molds that were shaped to form the characters of the alphabet. He poured hot metal into these molds. When the metal cooled and was removed, he had a piece of type. Each tiny letter was made separately and by hand—a slow and tedious process.

Gutenberg's type was assembled in the correct order by hand and placed in a large, clumsy wooden printing press. The type was inked by the printer, who then placed a damp sheet of paper over it and slid the whole thing under the press. By turning a huge wooden screw on top, a large wooden plate forced the paper firmly against the inked type. The screw was then backed up, the paper removed, and the process repeated. The printed sheets were hung on lines to dry just as your mother hangs the washing.

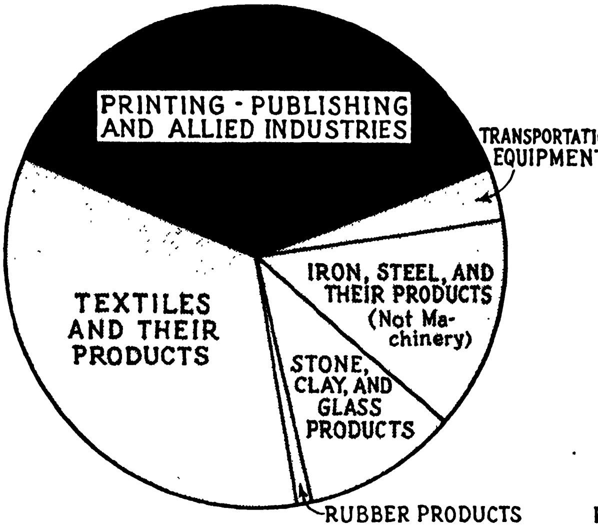
Gutenberg's invention proved a most important contribution to the world. It made possible books that were better and cheaper than any ever before produced. With books low in cost, all of us can afford to own and use them.

Page 5 will give you an idea of the number of people now employed in printing, engraving and etching, bookbinding, and photography.

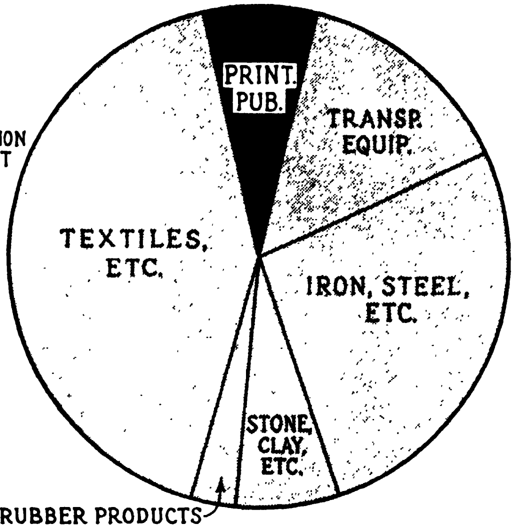
SUMMARY

Modern industry depends upon the graphic arts not only for its essential office forms but also to advertise its products and services to the public. The medium through which most of this is done is the printing trade, which includes composition, presswork, and binding. The type, either machine-set or hand-set, is printed on presses that range in size from the small hand press which prints a few hundred sheets an hour to the complicated rotary press making 52,000 copies an hour. The history of the graphic arts is a slow and long one from the first crude scratchings on the wall of the cave man through the hand-lettered manu-

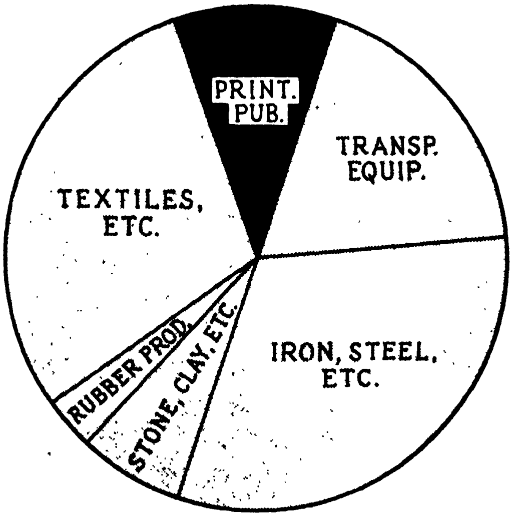
THE GRAPHIC ARTS IN INDUSTRY



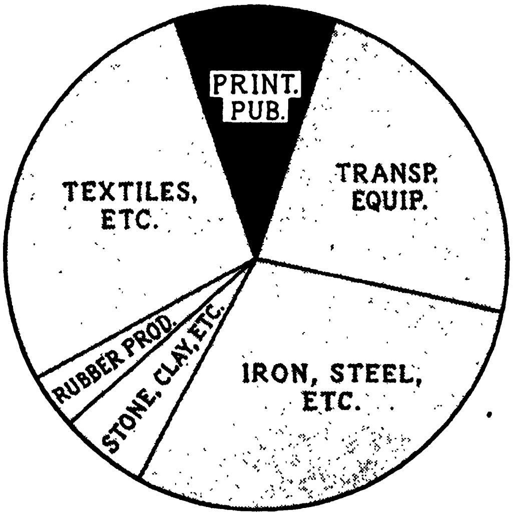
NUMBER OF ESTABLISHMENTS



NUMBER OF WAGE EARNERS



AMOUNT OF WAGES PAID



TOTAL VALUE OF PRODUCT

UNITED STATES BUREAU OF LABOR STATISTICS script of the Middle Ages to the movable metal type of Gutenberg which made possible modern industrial printing and bookmaking.

QUESTIONS

1. What are the graphic arts?
2. How important is the printing trade?
3. What people used papyrus and where did they find it?
4. What is parchment? Is any real parchment used today?
5. In what ways do you consider man's early records of importance to us?
6. What does the word composition mean when it is used in printing?
7. What did Johannes Gutenberg do in developing printing?
8. How does a pressman's work today differ from that of one who worked in Gutenberg's time?
9. Make a list of words that were new to you in this chapter. Do you know now what they mean?
10. What have the graphic arts done for you?

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CHAPTER II

USING TYPE

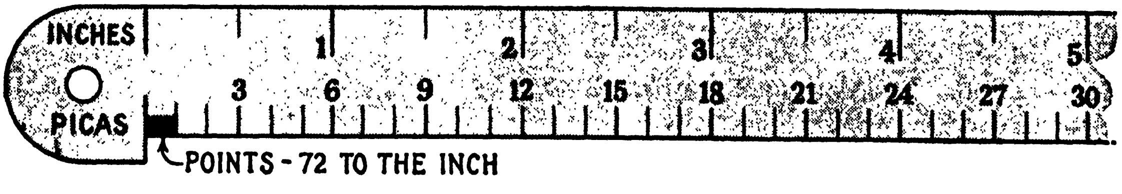
THE COMPOSITOR

The *compositor's* job is to set the type exactly as the work is written. The material to be set is called *copy*, and an old saying among printers is "Follow the copy even if it blows out the window." If the compositor thinks there is an error, it is his duty to notify the writer and secure the author's permission for changes. In a small shop the compositor also performs the duties of layout man, that is, he plans the form and selects the type to be used.

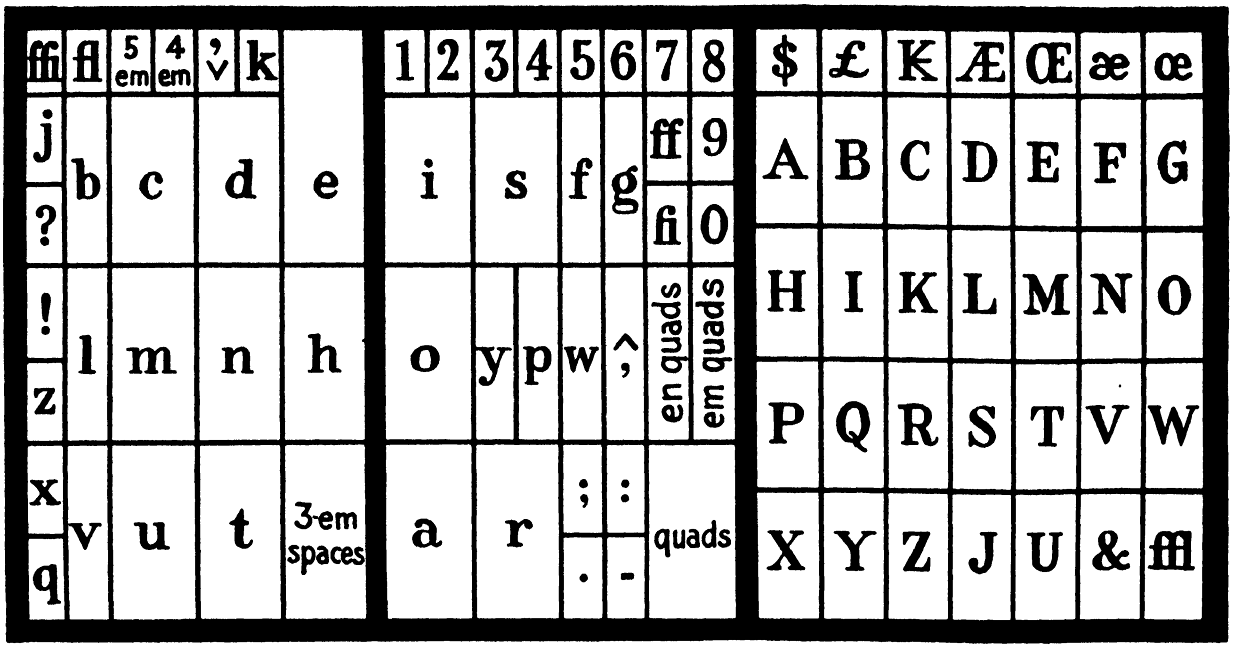
The tools a compositor uses when working by hand are a composing stick, line gauge, and tweezers. The *tweezers* are used only when you cannot make a correction with the fingers. The *stick* is a shallow metal tray having three raised sides. In this the compositor assembles type characters in their proper order for printing. There are several styles of composing sticks. The one thing common to all is the movable side. The stick is built so that this side can be adjusted to accommodate the length of line desired by the compositor. Page 11 shows a popular kind of stick.

The *line gauge* is the printer's rule, similar to our foot rule, and is used for measuring nearly all composing materials except type. It is marked in *picas*, six to the inch. Half picas, or nonpareils, contain 6 points. The *point* is the printer's standard unit of measure. It is most often used to determine the body size of type. There are 12 points in a pica and 72 points in an inch. Ordinarily foundry type comes in 6, 8, 10, 12, 14, 18, 24, 30, 36, 42, 48, 60, 72, 84, 96, 120, and 144 points. Most newspapers are printed in 8-point type; library books are generally made in 10-point. Many schoolbooks are printed in 12-point type to avoid eyestrain. In the school shop you use a line gauge to measure the length of leads, slugs, and rules.

Leads and *slugs* are strips of type metal that do not print because they are not as



12 POINTS = 1 PICA
6 PICAS = 1 INCH
72 POINTS = 1 INCH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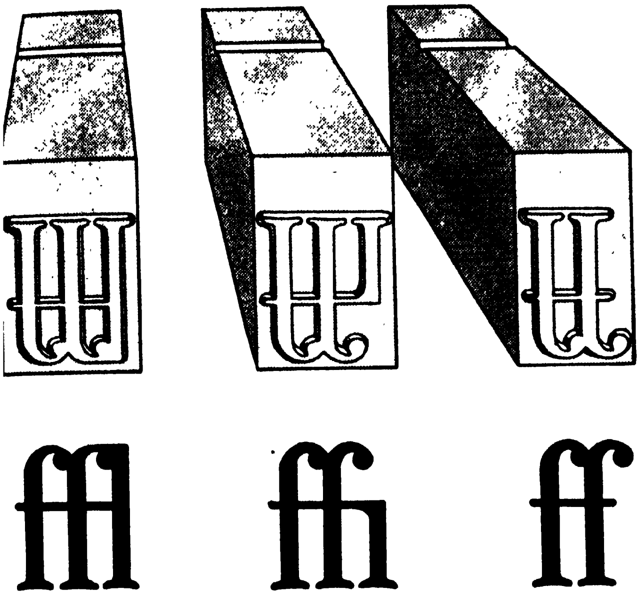
high as the type. They are used most often to spread type apart so that there will be more white space between the lines. This makes it easier to read the printed matter. Leads differ from slugs in being thinner. They are from 1 to 4 points in thickness. The 2-point size is used more often than the others. Slugs are 6 and 12 points in thickness, the 6-point size being used most often. *Rules* resemble leads and slugs except that they are as high as type and print lines. They are 2, 3, 6, and 12 points thick and are made either of type metal or brass.

USING THE TYPE

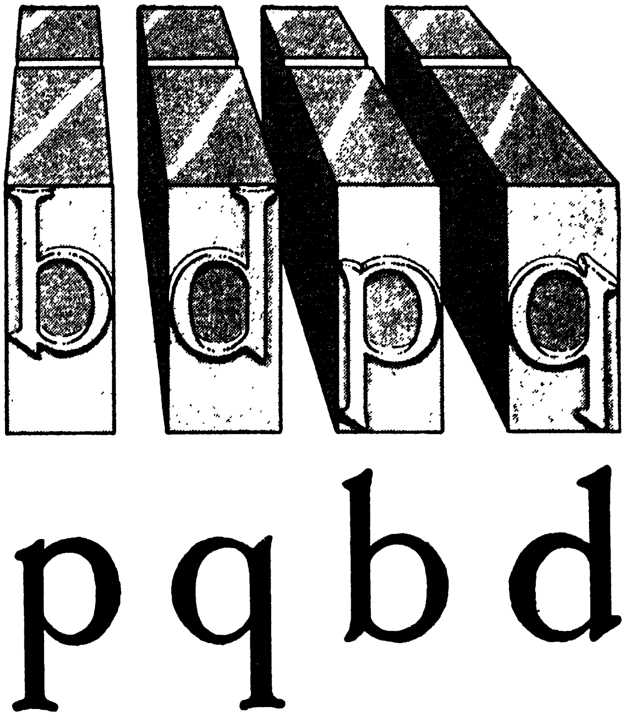
The case, or tray, that holds the foundry type we use in printing is called the *California job case.* The capitals are in the right-hand section; and the lower-case letters, figures, and spacing material occupy the middle and left sections. The California is the most popular style of type case; more than 90 per cent of the cases in use are of this kind. The case is divided into 89 boxes, each holding separate type characters. The *upper-case,* or capital, letters are almost in alphabetical order. The capital letters *J* and *U* were added to our alphabet last. Printers have placed them after the letter *Z.* Although the small, or *lower-case,* letters appear very much out of order, they are conveniently located. Those letters used most often are in a group at the front and center of the case. Those used less often are near the top and sides.

Type comes from the foundry in many sizes, and each size is kept separately. The large part of a piece of type is called the *body.* At one end of the body is located the *face,* or that part of the type which leaves the ink on the paper. In the body a nick has been placed. This nick tells the printer when the type has been placed correctly and is always away from the compositor. The base of a piece of type is called the *feet.*

Find the letters needed to spell your name on the print of the California case or in the case itself. Place a finger on each letter as you spell it to yourself. Look at the two characters in the upper left-hand corner and the one in the lower right-hand corner. These are two or more letters that often follow one another and are cast as one piece. Such pieces are called *ligatures.* Two of these are *ffl* and *fl*. Locate two more ligatures in the middle section.



LIGATURES (SEVERAL LETTERS CAST ON ONE BODY OF TYPE)



There are some characters on type that are confusing to beginners. The hardest are known as the four demons and are *b, d, p,* and *q*. Study the cut showing how the character appears on type and how it prints on paper.

A compositor must be healthy, have good eyes, possess speed and skill in his fingers, and be able to do precise work without getting nervous. Because he is

working constantly with written material, he should have a good understanding of grammar and composition.

The beginner, or *apprentice*, receives a salary of $16.75 a week for typesetting in larger cities, being employed five days a week for eight hours each day. There are several pay raises until the worker reaches the top of the wage scale, $56 for forty hours employment.

SETTING TYPE

You are now ready to set type in a composing stick as a printer would. You need a layout to follow so that you will know what to do. The printer calls this plan the *dummy*. The layout should show what is to be set, the way it is to appear, and the sizes of type that are to be used.

In industry the printer refers to each printing as a *job* and keeps a *job sheet* of the time, cost, and number of copies. So this will be your ——

JOB SHEET I

Make a layout similar to the one below, using your own name and address.

Harry Anderson *copy*

4635 California Street

Chicago, Illinois

A composing stick, four 15-pica leads, a case of 12-point type, printer's ink, brayer, paper, proof press, cloth, brush, and type wash will be needed.

Set the Composing Stick

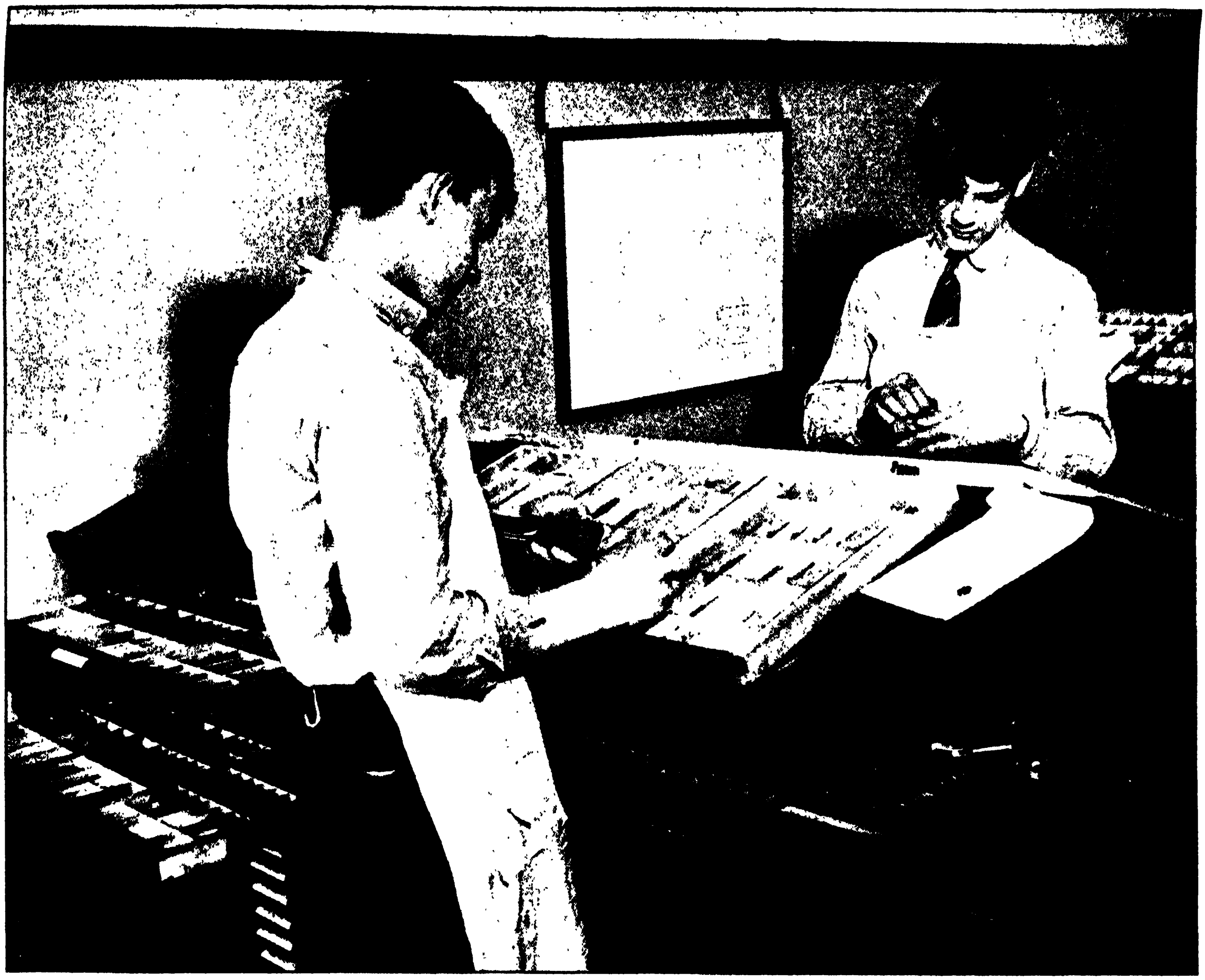
Remove your coat and roll up your sleeves. This allows more freedom for the arms, and the sleeves will not interfere with movements across the case. Set the composing stick to 15 picas and select either a lead or a slug to put in the stick. Measure the lead with a line gauge to be sure it is the correct length. Place the composing stick in the left hand with the open side of the tray held in such a manner that the thumb may be placed inside the stick. Notice the position of the thumb as shown on page 11. Tilt the bottom of the stick toward you slightly so that the letters will not fall when they are in position. This method of holding the stick will be awkward at first, but you will soon become accustomed to it.

Set Your Name

Take the letters from the box, one at a time, with the right hand and deposit them in the stick. Use capitals and lower-case letters. Take the type between the thumb and forefinger, and as you draw it toward the stick turn it face up with the nick away from you. Deposit the letter in this position in the left-hand side of the stick with the nick facing the open side. Place your thumb against the letter to hold it in position. Place the next letter to the right of this one and move the thumb as each letter is placed in the stick.

After each word a 3-em space is placed. *Spaces* are not as high as the rest of the type, so they make a white space between words. Set all the words that are to go on the line. If there are several picas of the line not filled with type, place 2- and 3-em quads so the line will be full but not tight. *Quads* are large-sized spaces.

The *em quad* is the basis of measurement for type spaces and is always square. A 2-em quad is one piece twice as wide as the em quad; a 3-em is three times the width of the em quad. An *en quad* is only one half as wide as the em quad. These quads are generally used to indent at the beginnings of paragraphs, to fill blank spaces at the ends of paragraphs, and to place on

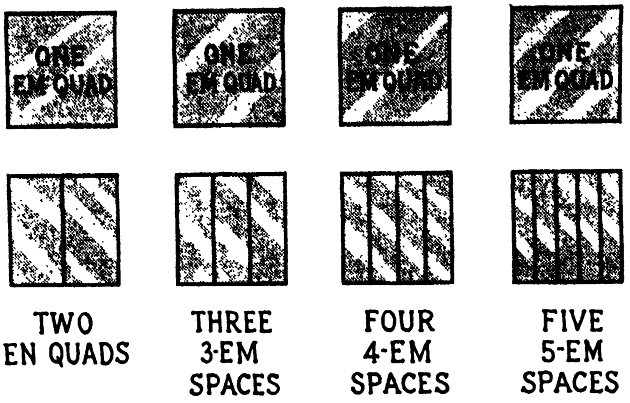


USING THE STICK TO SET TYPE

each side of a title when it is centered on a line. Spaces are thinner and are used mostly between words. There are three sizes, 3-, 4-, and 5-em spaces. A 3-em space is the next size smaller than an en quad and is one third as wide as an em quad. A 4-em space is one fourth the width of an em quad while a 5-em space is only one fifth as wide as the em quad.

Compare the quads and spaces with each other on page 12 and see how they are related to the em quad. Some boys remember the differences by comparing them with auto trucks and pleasure cars which differ in size. Trucks are used for large heavy work; so are quads. Pleasure cars are for lighter work; the spaces are used for lighter work.

Read the line to see whether there are any wrong letters that must be changed. When the corrections have been made, tighten the line by filling the small space remaining with 3-, 4-, and 5-em spaces. The spaces should be placed between the last letter and the first quad. The narrow spaces will later fall over and cause trouble if they are placed at the end of the line. The line is tight enough when the last space can be inserted with thumb pressure and the line does not fall when tipped for-



ward. Never use metal to force spaces or type into a line.

Set the Address

Follow the same method in setting the street address as you used for your name. Tighten the line with spaces and quads. Printers call this tightening *justification*. Be sure to use no more pressure than can be exerted with the thumb or fingers in inserting spaces or letters. After you have set the last line place several leads or slugs in the stick. A few important things to remember when setting type are:

Place a lead or slug in the stick before setting the type.
Have the nicks facing away from you when type is in the stick.
Hold the last letter placed in the stick with the thumb.
Use 3-em spaces between words if possible.
Never force spaces down with anything but the fingers.
Check each line for errors before tightening.

Ink and Proof Your Job

Ink is placed on the type by a rubberlike roller called a *brayer*. This is made from a mixture of glue, molasses, and glycerin. The same substances are used to make press rollers as this compound picks up ink better than rubber.

After inking the type, place it in the proof press and cover it with a blank sheet of paper. Push the press roller over the paper *once*. Carefully lift the paper and read your proof.

CARE OF TYPE

It is very easy to mar the face of type characters. Be sure that you do not allow any hard substance to come in contact with the type face. If you are using tweezers to remove type from the stick in order to make a correction, be careful that the tweezers do not slip and mar the face. If this should happen, discard the type, as it should not be used again.

After pulling the proofs, the type needs to be carefully cleaned. Most of the ink should be wiped off with a dry cloth. Then pour some benzine or gasoline into the type brush and briskly scrub off the remaining ink. If available, use a type wash that is not inflammable. Any ink left on the type tends to harden. If this happens repeatedly, the type, instead of showing the outline of the character, resembles a blot. It is difficult to clean type after the ink has been allowed to harden.

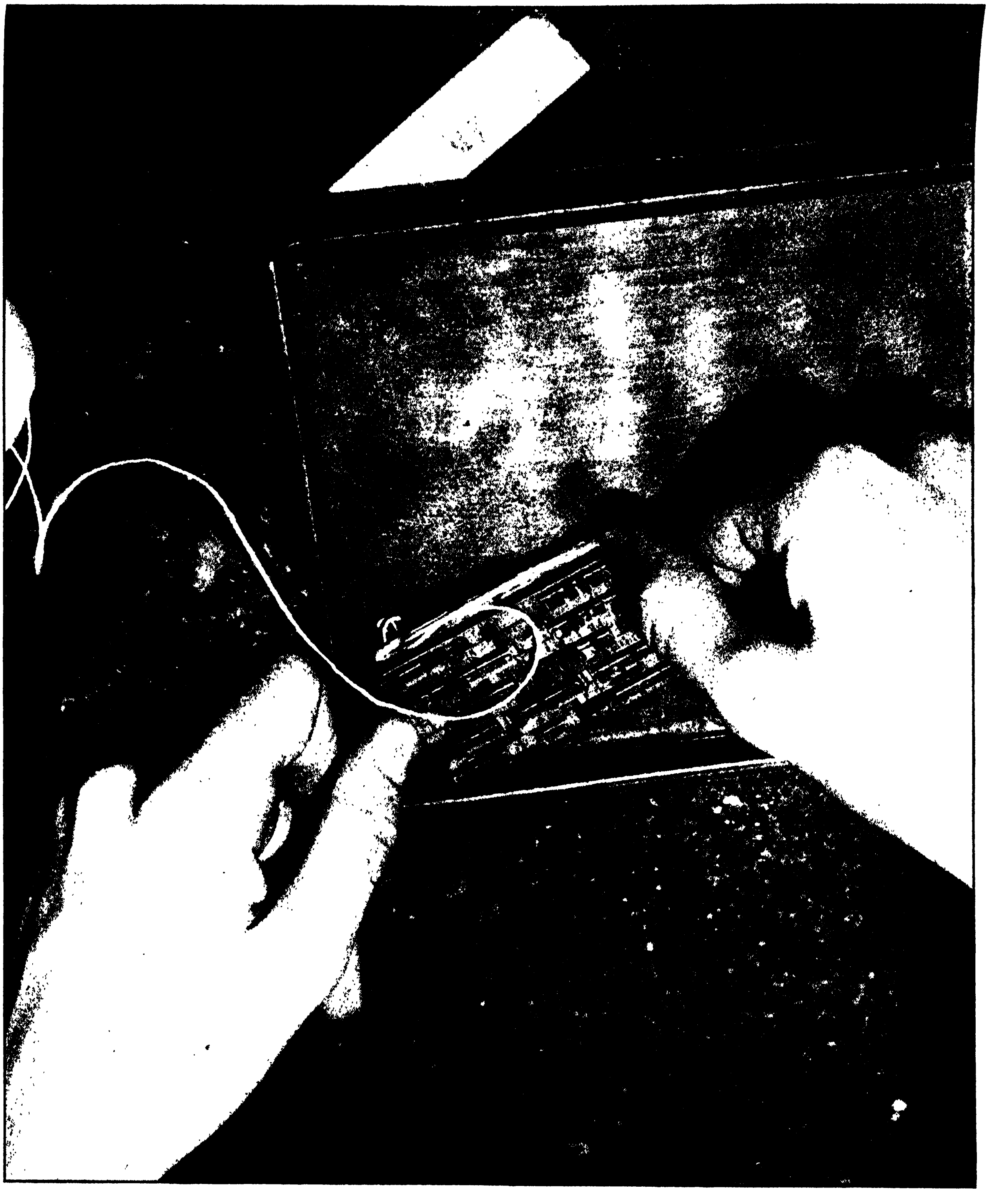
TYPESETTING POETRY

There are many ways in which to indent poetry. The method to be used is given by the author so that the proper swing or rhythm will result when reading the poem. Secure a book of poems and notice the various styles of indentation used by authors for their work.

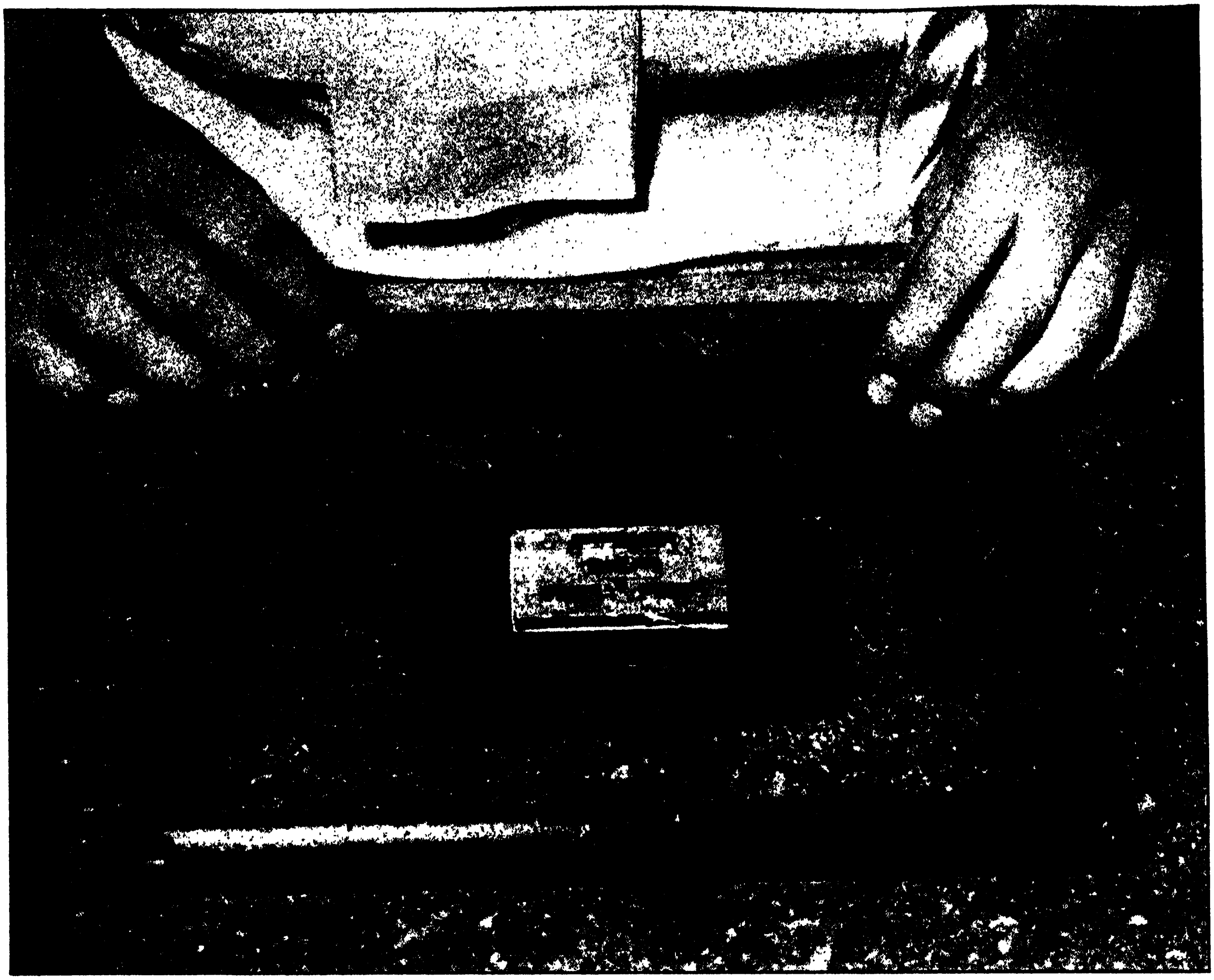
Few people allow enough margin on the printed page. A liberal amount of white space improves the appearance of the page. White space is secured by placing a lead or slug between lines of type and several slugs between stanzas.

Job II

A poem, case of type, composing stick, galley, line gauge, six to eight leads or slugs, and cord are to be used in this job.



TYING THE FORM WITH CORD



LOCKING TYPE IN THE CHASE—BUILDING OUT WITH WOODEN FURNITURE

Place a slug in the composing stick, and set your name on this slug followed by the period when you are in the shop and the job number. Do this for each job as it helps you in finding the stored work to be used again in a later period.

John Wheeler period 3-4 job 2

Place a slug or lead on top of each line of type after it has been set. An experienced printer does not follow each line with a lead. He sets his copy *solid* so that he can get more sentences in the stick.

First read all instructions. Then select a poem of four to six stanzas you wish to print. Each stanza should consist of about four lines. Divide the poem with a friend so that each of you will set an equal amount.

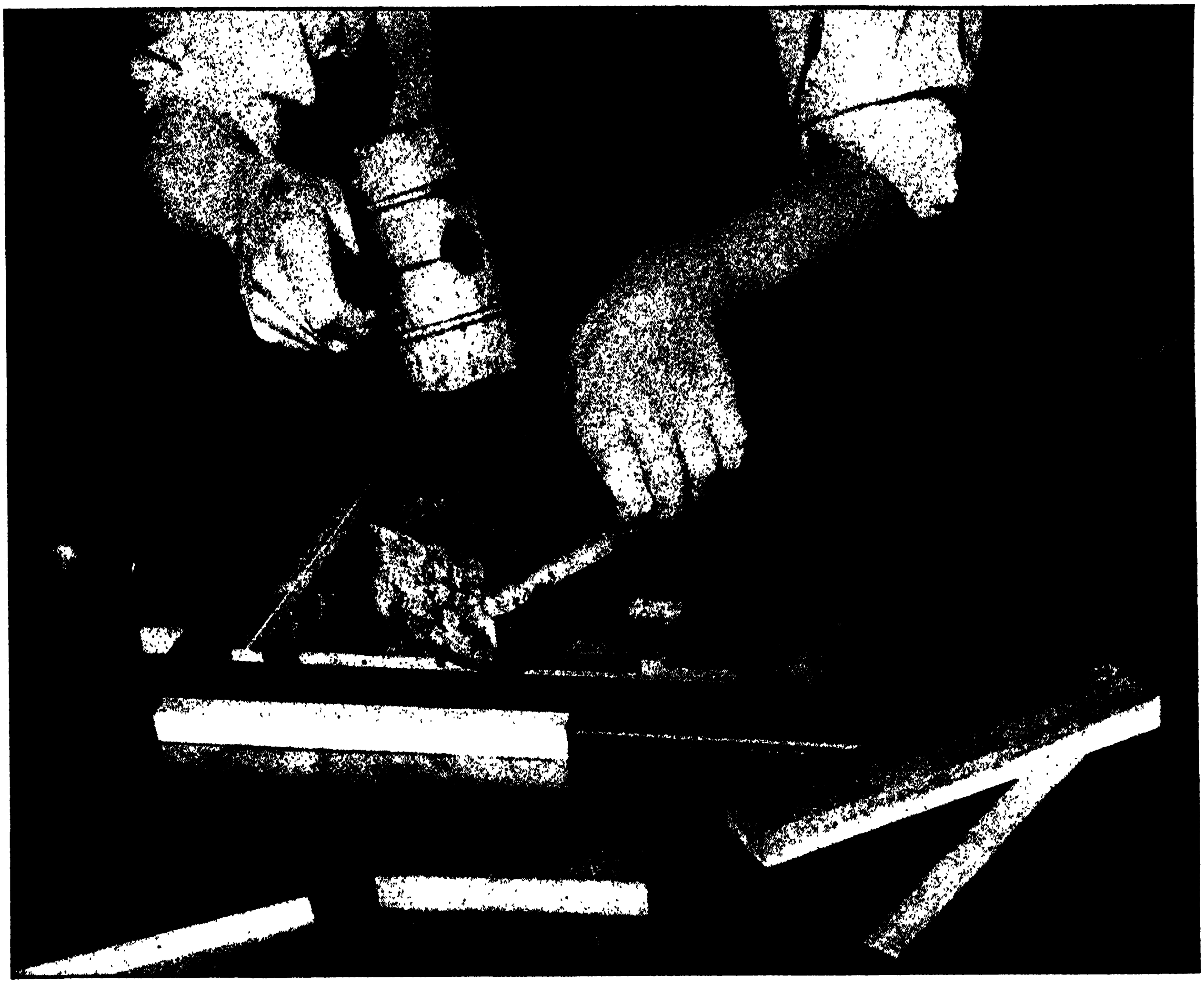
You may set this poem by yourself if you wish:

Horses of the Sea

The horses of the sea
  Rear a foaming crest,
But the horses of the land
  Serve us the best.

The horses of the land
  Munch corn and clover,
While the foaming sea-horses
  Toss and turn over.

CHRISTINA ROSSETTI.



LOCKING TYPE IN THE CHASE—LEVELING THE FORM WITH PLANER AND MALLET

Set the Poem

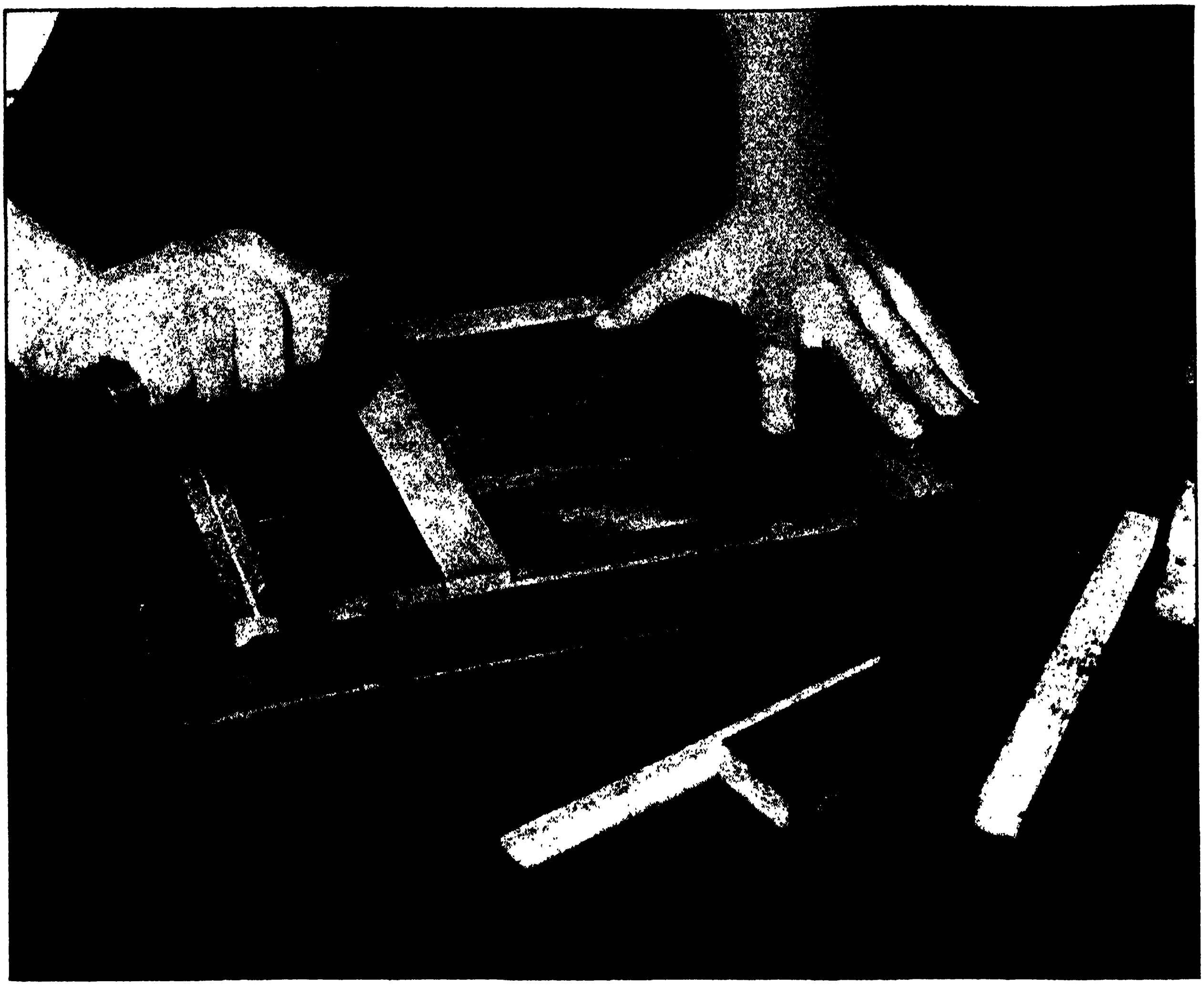
To determine how long to set the composing stick, pick out the longest line of the poem and set it in the stick. With a line gauge measure the length and select slugs just a little longer. *Be sure each of you sets his part of the poem exactly the same length.*

The boy having the title is to set and *center* it in the composing stick following it with a slug. Centering is done by placing an equal number of quads on each side of the title. Then set the rest of the poem as it appears on the original copy. Use 3-em spaces between all words.

The boy who does not have the first stanza will set his part as soon as he knows the length of the job in picas and has placed his name, period, and job number in the stick.

Ink, Proof, and Correct Your Job

Take a proof in the stick of the completed job and mount it in your notebook even if it contains errors. Indicate the errors, using proofreader's marks. (You will find these marks in the dictionary or in some English books.) Correct the form after wiping the ink from the type with a cloth.



LOCKING TYPE IN THE CHASE—TIGHTENING THE QUOINS

Take a second proof and mount it in your notebook below the first. Mark this one for errors and make any necessary corrections.

On a perfect proof have your instructor place his O. K. Such a proof is called *clean.*

Wipe off the type with a cloth, then wash it with type wash and a brush.

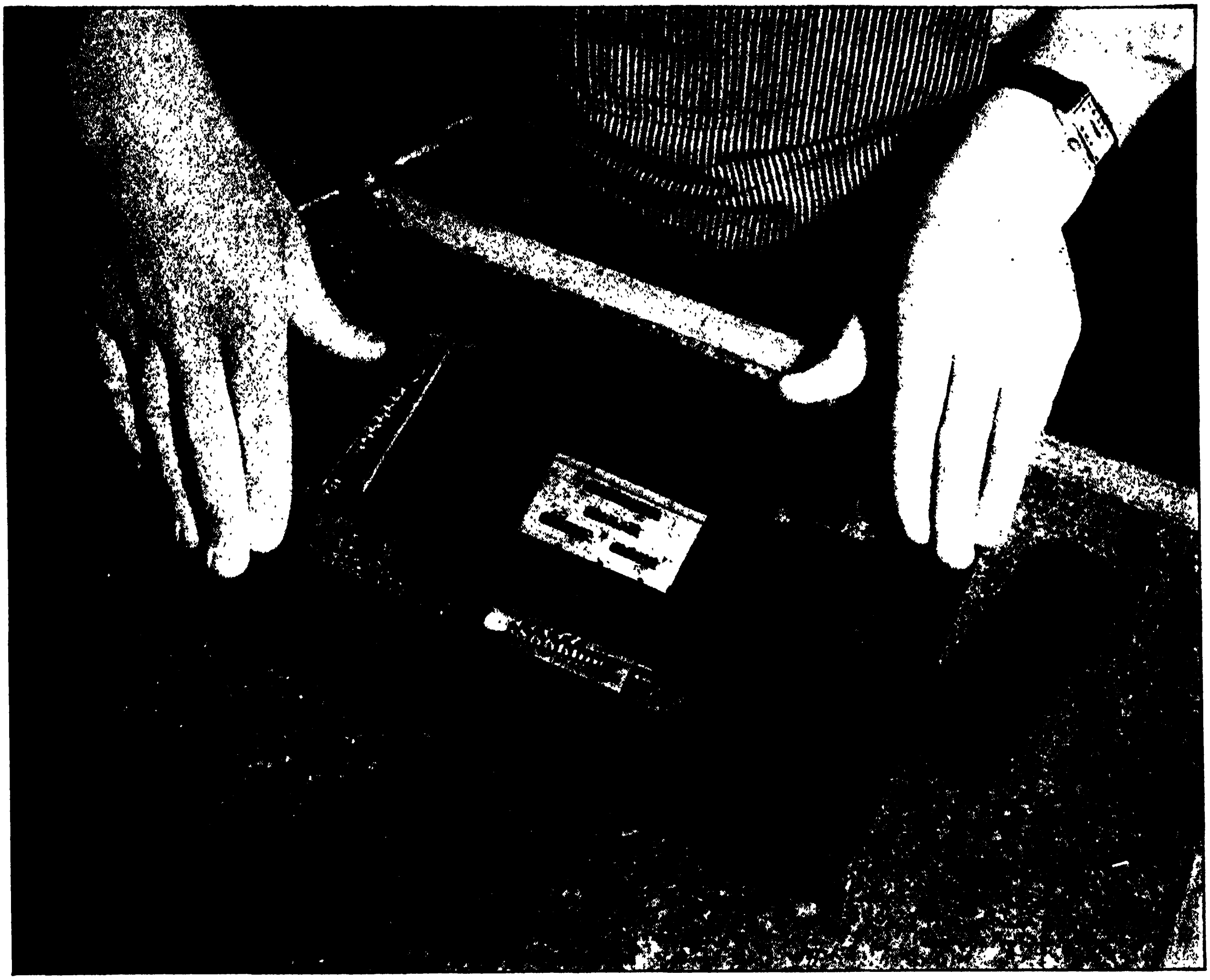
Tie the job with a cord and store it in a galley until all the stanzas are complete. They may be used in your next job.

LOCKING TYPE IN THE CHASE

Before anything can be printed, it is necessary to lock it securely in a rectangular steel frame. The printer calls this steel frame the *chase.* There is a systematic method of *locking up.*

Below are described the things necessary for locking material to be printed in a chase. Ask your instructor for the *form,* the matter you are to lock up and place in the press. He may give you the poem you have set or a linoleum engraving.

You will need the *form*—type or a linoleum cut—wooden *furniture*—pieces of wood used to hold the form in the chase, *reglets*—smaller pieces of wood to fill spaces between the furniture and the chase—leads, slugs, and a chase.



LOCKING TYPE IN THE CHASE—TESTING THE LOCK-UP FOR LOOSE TYPE

Quoins—metal wedges—will be used to lock everything securely in the chase. They are tightened by a *quoin key*. A *type planer* and *mallet* will be needed to level the form before tightening the quoins.

To lock up, place the form on a smooth, level surface larger than the chase. Printers use a marble or steel table top they call an *imposing stone* on which to do this work.

Over the form a chase is placed. Build between the form and the chase with wood furniture. If the form is only a line or two, first add a dozen leads and slugs above and below it. Be sure to leave a little room on the far side and the right-hand side near the chase for the quoins. These are the wedge-shaped locking devices.

Insert the quoins in the openings; and, if they are too loose, slip in a reglet to fill the space. Untie the type form and then tighten the quoins with the fingers as much as you can.

Place the type planer, which is the thick hardwood block, on top of the form and tap the top of the planer with the mallet. This levels any type that is above the rest. Be sure to tap lightly and keep moving the block while tapping on it.

Next use the quoin key to tighten each quoin a little. Shift the chase slightly, plane

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LOCKING UP IN A LARGE SHOP

again, and go over the quoins again tightening each until all are quite firm. Test the lockup by putting part of the key under one corner of the chase. Rock the chase back and forth and watch carefully to see whether any type is loose and slips down. While the lockup is still held up, press down on the form with the fingers to see whether there are any loose lines or letters. If there are, the spaces will have to be changed until none of the lines or letters slip. The form is now ready for the press.

SUMMARY

Before type can express the thought desired by the author, it must be taken from the case in which it is stored and assembled into meaningful sentences. The man who does this work is called the compositor. He uses the stick and line gauge to set type in the manner indicated by the plan or dummy he has made. Leads, slugs, rules, spaces, and quads are used to secure the desired location of the printed words on the page. While still in the stick, the type is proofed and any needed corrections made. Before type can be printed it must be locked in a chase using the pieces of furniture that are designed to fill the space between the form and the chase. The lockup must be tested for tightness while still on the stone, and it is then ready for printing.

QUESTIONS

1. Which is the larger, a pica or a point?
2. What are the three tools a compositor uses?
3. Are slugs thicker than leads?
4. What is the name of the tray that holds your type while you are setting it in place?
5. How many picas are in a space 2 inches long, 1½ inches long, 3 inches long?
6. How is ink removed from type?
7. What is the principal use of leads and slugs?
8. What is each of the following and for what is it used: (*a*) chase, (*b*) quoin, (*c*) wooden furniture?
9. What size spaces are usually placed between words?
10. Are lines of type justified before or after making corrections?

TOPICS FOR DISCUSSION

1. How to Care for Type.
2. Making Printer's Ink.
3. How to Set a Line of Type.

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CHAPTER III

THE PLATEN PRESS

You now need to know about the *platen* or *Gordon* press as this is the one found in most school shops and the kind you will use in your printing. Although cylinder and rotary presses are too large and expensive to be regular equipment in the usual high-school shop, their place in industry will be explained in Chapter V.

The platen press is really rather simple, and you will find it pleasant to operate one. It is a heavy, large machine of several moving parts. A cast-iron base or body is the support. Power is applied by an electric motor, a foot-power arrangement, or a hand lever. In industry most Gordon presses are powered by electric motors and may be operated at a number of different speeds. This speed is determined by the skill of the operator and the size of the sheet used.

At the back are located the ink *disk*, the *bed*, or place to put the type, and *rollers* to transfer ink from the disk to the type.

On the left side of most Gordon presses is a large iron wheel, the *flywheel*. This keeps the press running at an even rate of speed. Near the flywheel is a lever. When this lever is pushed back, the machine is out of gear and the type will not touch the blank paper. When the lever is forward, the type prints upon the paper that the pressman puts in the machine.

A flat, level piece of steel covered by several sheets of paper is what the pressman sees when he faces the front of the press and looks down. This is called the *platen* and is the reason for the name *platen press*. Several levers and geared wheels open and close the platen against the type. When it is forced against the type, the blank paper receives a print, or impression. When the platen opens, the pressman quickly takes out the printed paper with the left hand and with the right puts in a blank sheet.

Inventors have perfected a method of feeding the platen press by suction. Rubber tubes and cups are so arranged that when the press opens one set of cups picks up the printed sheet while the other takes a blank sheet from the feed table and places it in the correct position for printing. The device is timed so that suction is created at the proper moment to hold and carry the paper. One pressman can operate several machines with such a device.

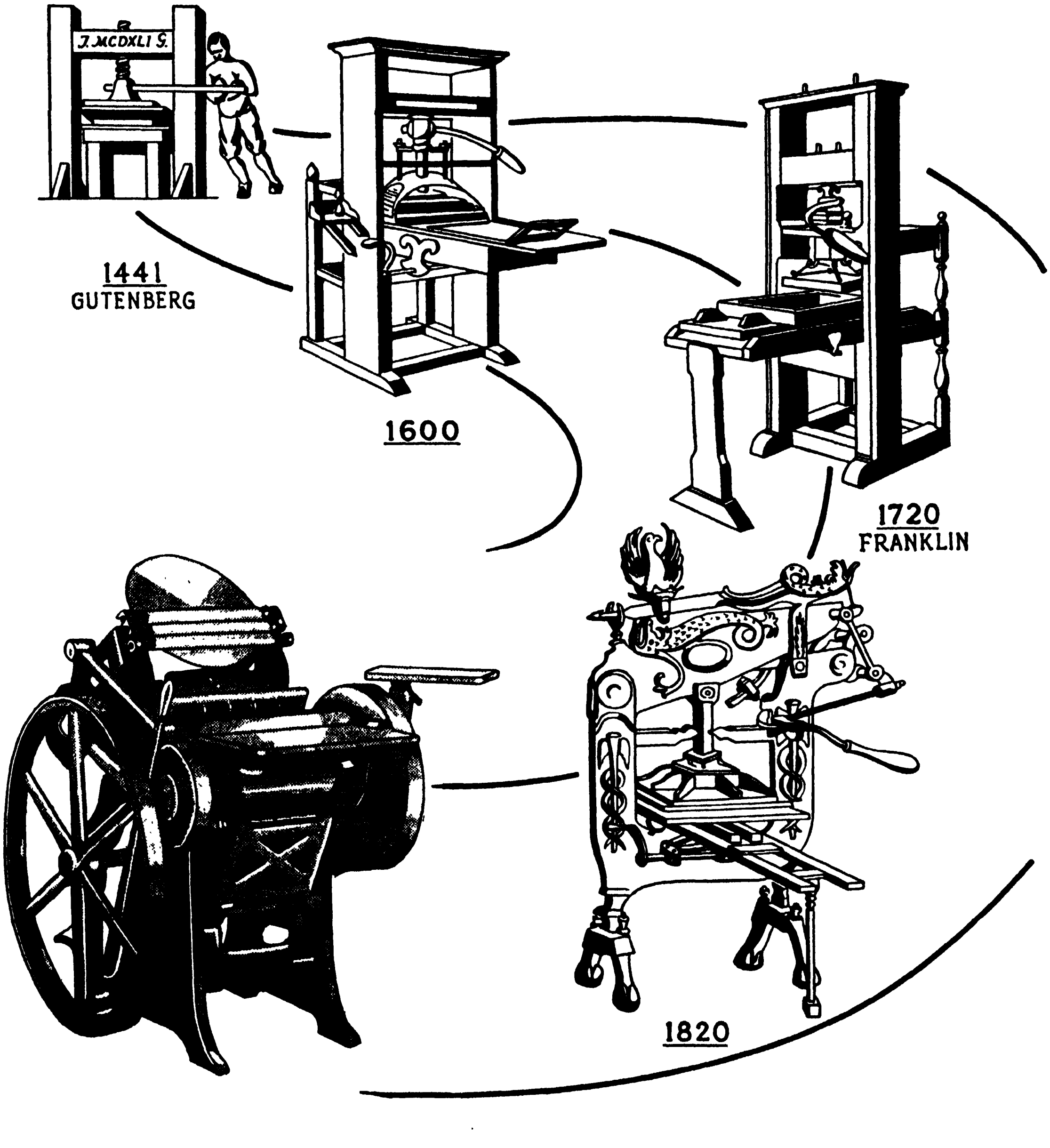
A variety of work is printed on the Gordon press. Some jobs are tickets, cards, envelopes, stationery, letterheads, sale bills, office forms, notices, and small booklets.

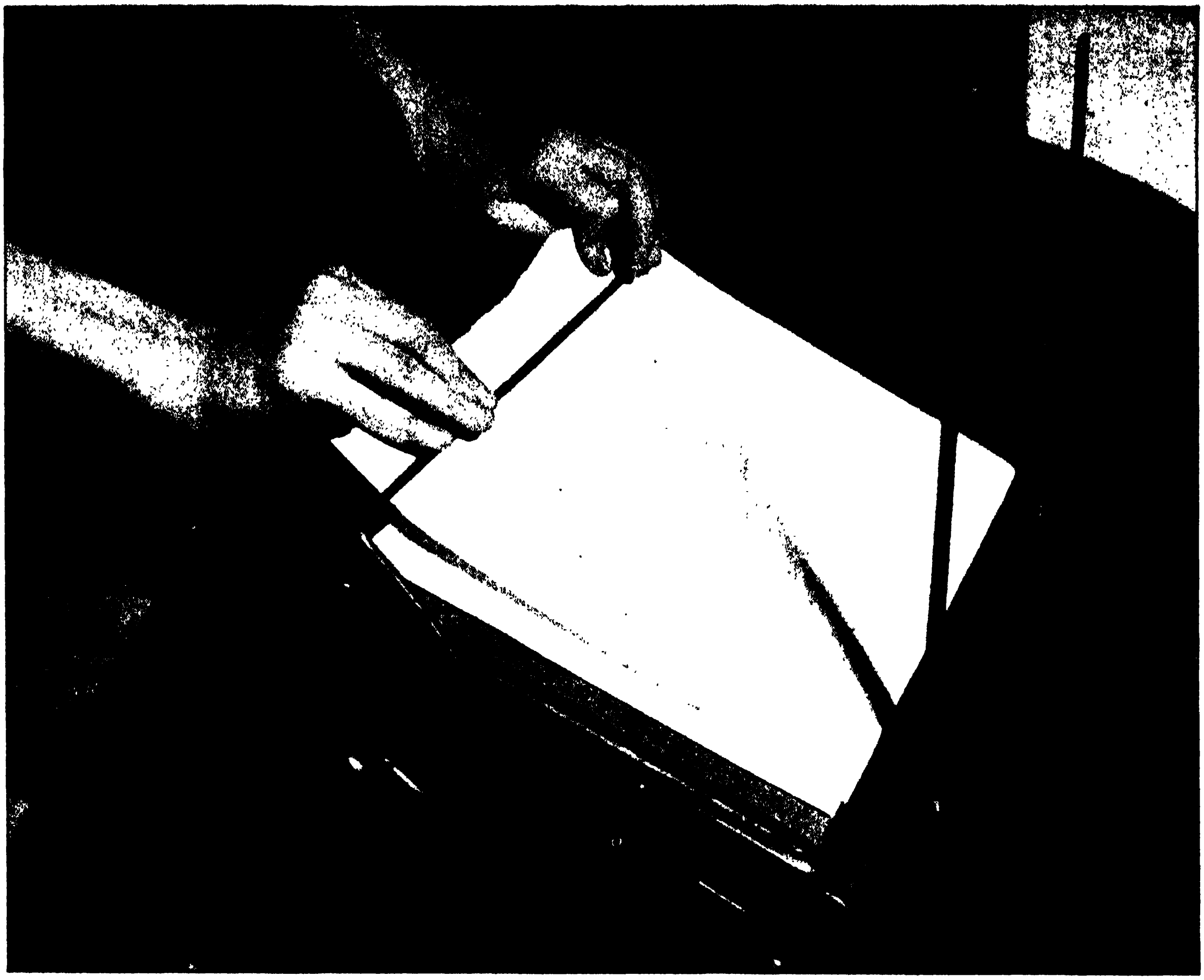
MAKING READY ON THE PLATEN PRESS

An interesting task in the print shop is that of preparing the press for printing.

OLD STYLE PRESSES

CONTRASTED WITH A LATE MODEL PLATEN PRESS





STRETCHING THE DRAW SHEET

This is an important step and requires a skillful worker with the ingenuity necessary to secure a good print.

The first step in preparing the press for printing is inking. Printer's ink is made chiefly from thick varnish and color. It is about the thickness of tooth paste and comes in tin cans or soft metal tubes. Pressmen place a small dab of ink on the left side of the ink disk about where the number eight or nine would be on the face of a clock. The rollers spread the ink evenly as they run back and forth. Place a small amount of ink on the press at the start and then add to it until the required amount is secured. This prevents any overinking.

The form is now placed in the press. To pick up the form, grasp the two far corners of the chase, one in each hand, and move it up and down one-half inch or so several times to see whether all the type is locked, then quickly lift it. *Always carry the form in a hanging position.* This is done to prevent any possibility of an accident, such as type dropping out of a poor lockup. Lift the form into the open press against the bed, and lower it so that the bottom of the chase rests firmly against the bottom projections, or lugs. Push the chase and type against the bed of the press and to the left and fasten the chase under the clamp at the top of the bed. If the *grippers*, or fingers, are in front of the type they should be loosened and moved toward the sides. These grippers will crush the type if they are in front of the form when the press closes.

After the press is inked and the form in place, the pressman puts a padding of paper on the steel platen. This he calls *dressing* the platen. The old padding is discarded after loosening the top and bottom *bale*, or clamp, of the platen. The new padding, called *tympan*, is prepared thus: Insert a sheet of tough paper and two sheets of Manila paper below the bottom clamp. A tympan paper is especially made for this purpose. It is hard, tough, and oily. A heavy wrapping paper will take its place. On the metal platen is now placed a sheet of pressboard for packing. Pressboard is stiff hard paper made especially for presswork. Two or three sheets of book paper are placed above it. The *draw* sheet, or top sheet, is then pulled tight and the top clamp put in place.

To see whether more packing is needed, take a proof of the form on the draw sheet. Then place the *gauge* pins, which are little metal clips, in the draw sheet so that the printed paper will have the proper margins. Place a sheet of paper in the press and take a proof. If the ink is too light in some spots, paste extra paper on the book paper packing back of the area which appears dim on the draw sheet. Look at the back of the proof to see whether any marks are punched through the paper. If there are such marks, it will be necessary to take out a sheet or two of the packing.

PRINTING

Before a job is *run*, or printed, the press needs to be oiled just as your father's automobile needs oil when it is being used. The oil keeps the moving parts from wearing and makes the machine run more easily. Secure an oiling chart from your instructor, and oil the press according to directions. Be sure to wipe off excess oil with a cloth.

If such a chart is not to be had, look for all the oil holes. They will be found where there are moving parts. A friend might help by slowly turning the flywheel by hand so that the moving parts may be located. *Never oil any machine while power is applied!* Many fingers have been lost or arms broken while trying to oil or adjust moving machinery.

Clean hands are necessary before feeding the paper into the press. The printed sheets cannot be used if there are dirty finger marks on them. Take a *lift*, or stack of paper, that is the correct size and place it on the feed table to the right of the press. Start the press and feed the paper against the gauge pins with the right hand when the press is in the *open* position. After the press has closed to print and then reopened, take out the printed sheet with the left hand and feed a blank sheet with the right. The printed sheets are placed on the delivery board in a neat stack by the feeder.

In operating the press, *the feeder must be careful to remove his hands from the press when it starts to close.* If a piece of paper has been fed in crookedly let it print, and discard it when it has been taken out. *Do not risk smashing your fingers by a grab into the press.*

Avoid printing on the tympan. If you print on it, the ink will be pressed on the back of the next six or eight sheets, spoiling them. This is what printers call *offset.* If you print on the draw sheet by mistake stop the press, moisten a clean cloth with benzine, and rub the fresh ink from the sheet. Allow the benzine to evaporate before printing again. Be careful when removing printed sheets that the fingers do not touch the wet ink and make a mark on

FEEDING THE PLATEN PRESS

the next sheet. This is another cause of offset. Stacking freshly printed sheets too high causes offset from the bottom sheets because of the weight of paper pressing against the damp ink on the lower sheets.

Most ink takes from twelve to twenty-four hours to dry. Industry overcomes this in several ways. Some printers purchase ink that contains chemicals to cause quick drying. This is the ink used on high-speed presses. Others run the paper that has just been printed between heated rollers before it is stacked. Still another method is to spray the printed surface with a clear liquid that dries almost at once.

CLEANING TYPE

It is important to clean all ink from the form and press as soon as the run has been completed. Printer's ink dries very hard and is almost impossible to remove later.

Take the form from the press and place it on the imposing stone. This is the flat table with a metal or stone top on which the form was made up. Wipe off as much of the wet ink as is possible with a soft cloth. Most of the ink is removed with this dry cloth so that it will not be washed down between the type when the liquid is used. That would make dirty type. Now, pour a noninflammable type wash on the brush used for cleaning and scrub the form until it is free of ink. If you use benzine or gasoline, *remember either ignites very easily and that the vapors are explosive.*

The press is cleaned by using old newspapers to blot as much ink as possible from the rollers and ink disk. Place a half sheet of newspaper on the disk and run the rollers over it. Do this until there is very little ink left on the machine. Then wet a piece of soft cloth with type wash, benzine, or gasoline. Wipe the remaining ink from the rollers and disk. Be sure to get the ink off the ends of the rollers and the edges of the disk.

All paper and cloth used in cleaning the press *must be placed in a metal can that has a metal cover.* If these are left about the shop, they may burn because of *spontaneous combustion.* This is a fire caused by heat generated within certain materials themselves. No match or flame is needed to start the burning.

The pressman often continues printing with the same colored ink the following day. If that is the case, he may put a few drops of machine oil on the ink disk when he finishes a job and spread it over the ink with the rollers. This will prevent the ink from drying as the oil keeps out the air. Of course, this oil must be removed with newspapers before starting to print. When this method is used, the type has to be removed from the press and completely cleaned even though the press is not.

Sometimes workmen are careless and do not clean the ink from the form. It hardens on the type and the *e*, *o*, *a*, and other letters that have inside recesses or cavities become filled with ink and dust. These letters then print as black spots on the paper. A special chemical can be purchased to eat such ink away, or the type may be assembled, tied, and immersed in a lye and water solution overnight. The type should be thoroughly rinsed with clear water and scrubbed with a brush before distribution.

DISTRIBUTION OF THE TYPE

After the job has been printed and the cleaning is finished, the form is ready for distribution or storage. By *distribution* is meant putting each article in its proper place so that it can be found when wanted. Printers call a form that is not needed again *dead matter.* The quoins are unlocked and placed in the box or drawer. Care must be taken to return the wood and metal furniture to the proper place with each size in the correct compartment. All leads and slugs at the top and bottom of the form should be separated for length and thickness and placed in the lead and slug bank.

Then the form itself is ready for distribution. Foundry type is expensive; so when the work is printed, we put the type back in the case. It will be best to tie the type with cord and then slide it into a galley. Find the correct type case and put the type in it. Be sure to put the right letters in the proper compartments or you will soon have a *dirty* case. That is what the printer calls a case when the type has become mixed.

The easiest method of distribution is to pick up a word at a time between the thumb and middle finger. Read the word and then spell it letter by letter to yourself as you drop each character into its proper box or compartment. If the word is too long, pick up part of the word. If the characters are stuck together slightly, roll the type back and forth between the finger and thumb a time or two. This separates the characters. Eyestrain is lessened because in distributing type this way you look only once at a word or group of letters. *Do not pick up a letter at a time and look at it.* This is a waste of time and an inaccurate method. By using the first method, forms can be distributed much more quickly.

DISTRIBUTING TYPE TO THE CASE

Live forms are those that are to be printed often. Too much time would be used in setting such work for each printing; so the matter is tied and stored for future use. If there are not enough leads and slugs in the bank, these may be taken from the live form and returned when another printing is to be made.

To become a pressman, the worker serves as a junior press feeder for two years. The wages received for this work in Chicago are about seventy-five cents an hour. You work in the pressroom as an apprentice for four years. At the end of this period, you are ready to be a pressman. The salaries earned in operating presses range from $48 to $70 a week in and near Chicago. In large cities the salary would be about the same; but in smaller towns the pay would probably be less. A pressman should have good health, possess excellent eyesight, and be interested in machinery.

The pressman has a position that pays well, regular hours of work, pleasant surroundings, a healthful workroom, and a chance to advance into executive positions. The disadvantages are night-shift work and the danger in working around moving machinery.

STRAIGHT COMPOSITION

When setting type for straight composition, the first word is indented according to the width the work is set. The copy for Job III explains this practice. *The letters at the beginning and end of the lines must touch the composing stick.* Set the work using 3-em spaces between the words.

When the end of the line is reached, change some of the spaces for larger or smaller ones so that the line fits snugly. A space or quad may never be placed next to the stick when setting straight composition. The beginning and end of the paragraph are exceptions to this rule.

Most schoolbooks, magazines, and newspapers are straight composition. Compare the right side of this book with the same side of a typewritten page. Note the even margin of the book. When setting a paragraph that has the right and left margins even methods of justification different from those you have used are necessary. If, after setting the line and using 3-em spaces between words there is still a little space left, take out some spaces and put en quads in their places. En quads are just a little wider than a 3-em space. This will lengthen the line and make it fit snugly. If a few letters of the last word will not fit in the composing stick, take out some of the 3-em spaces and use the narrower 4-em spaces to shrink the line so that it will fit in the stick. Notice the spaces between words on several lines in this book.

Job III

An Indentation Rule

> In narrow measures of composition it is customary to indent the first line of each paragraph one em of the type body used. If the lines are longer than 18 picas, it is usual to indent 2-em quads. Large sizes of type will take less indentation while smaller sizes must be indented more.

A case of type, composing stick, leads or slugs, string, and a galley are needed for this job.

Read all directions first and then set the composing stick the length the instructor suggests. Insert a lead or slug and set your name and class period upon it as in the previous job.

Jack Jones period 1-2 job 3

Set the copy given above or a paragraph substituted by the instructor. Indent it an em quad and use 3-em spaces between words.

When the paragraph is complete pull a

proof, paste it in your notebook, and mark the errors.

Then wipe the ink from the type, make corrections, and proof until you secure a clean proof.

Lock the job in a chase and print some copies.

Wipe off the ink and wash the type.

Distribute the characters to the case, taking care to get each character in the proper box.

RULES AND LEADERS

Solid and broken lines are printed by using rules and leaders. Rules are made in strips of either type metal or brass while leaders are made similarly to quads and are of type metal.

Two types of leaders can be purchased, one to print periods and the other hyphens. These leaders guide your eye across a gap to the other end of the line. Laundry lists, tickets, price lists, information sheets, and some advertisements use them. Leaders are cast on en, em, and 2- and 3-em bodies. When setting a line of these, pick the 3 ems and fill the remaining space with ems and ens.

Rules are used to print solid lines. These are strips of metal type-high and are cut in pica lengths. Brass rules are much better than those of type metal. Brass rules may be used with either the top or bottom as the printing surface. This gives wide or narrow lines. Rules are used to form lines on books, stationery, programs, menus, and folders.

JOB IV

A case of type, composing stick, galley, leads, slugs, string, rules, and leaders are used on this job. Set the composing stick to 20 picas. Now set your name, period, and job number. Inspect the copy and follow it. Set the label with a lead between each two lines. Place the rule in position. Center PARCEL POST and set the label following the copy.

Copy

From:
Carl Lansbridge — Place
1433 N. Oaklawn Avenue — Stamp
Chicago, Illinois — Here

PARCEL POST

To:______________________________

Street ____________________________

City____________ State____________

After proofing and correcting your form, transfer the type to a galley and space with leads and slugs. Lock up and print a few copies for yourself on 3″ x 4″ stock. Clean the type and distribute it at the end of the job.

CALLING CARDS

Many people in the business and professional world find it convenient and sometimes necessary to have calling cards. Some people use cards for social calls. The student may find it interesting to print a few cards for his own use. Social and professional cards are generally small, and those for business use are larger.

When the card is to be used by a man as his personal calling card, the size is generally $1\frac{1}{16}$ x $3\frac{3}{16}$ inches. The size printed for ladies is $2\frac{1}{2}$ x $3\frac{1}{2}$ inches and the juvenile size most often used is $1\frac{1}{8}$ x $2\frac{1}{4}$ inches.

It should be remembered that most beginners want to place too much printed matter on their cards. The social card usually contains *only the name.* Some people also like their address printed in one lower corner. Business cards should contain the

Courtesy Chicago Public Schools

BOYS WORKING AT THE GRAPHIC ARTS

three "W's"—*Who—What—Where. Who* should be the most prominent.

Stock for calling cards is frequently made by a special die-cut process. This stock may be purchased in boxes of 500 cards. Care must be taken that the printing is well balanced and leaves the correct margin. Capitals, preferably plain dignified letters, should be used. The name should be in 10- or 12-point, and the address and telephone number should be in 6- or 8-point. There are many forms and designs that may be used. These depend upon the nature of the business and the information that is to be given on the card.

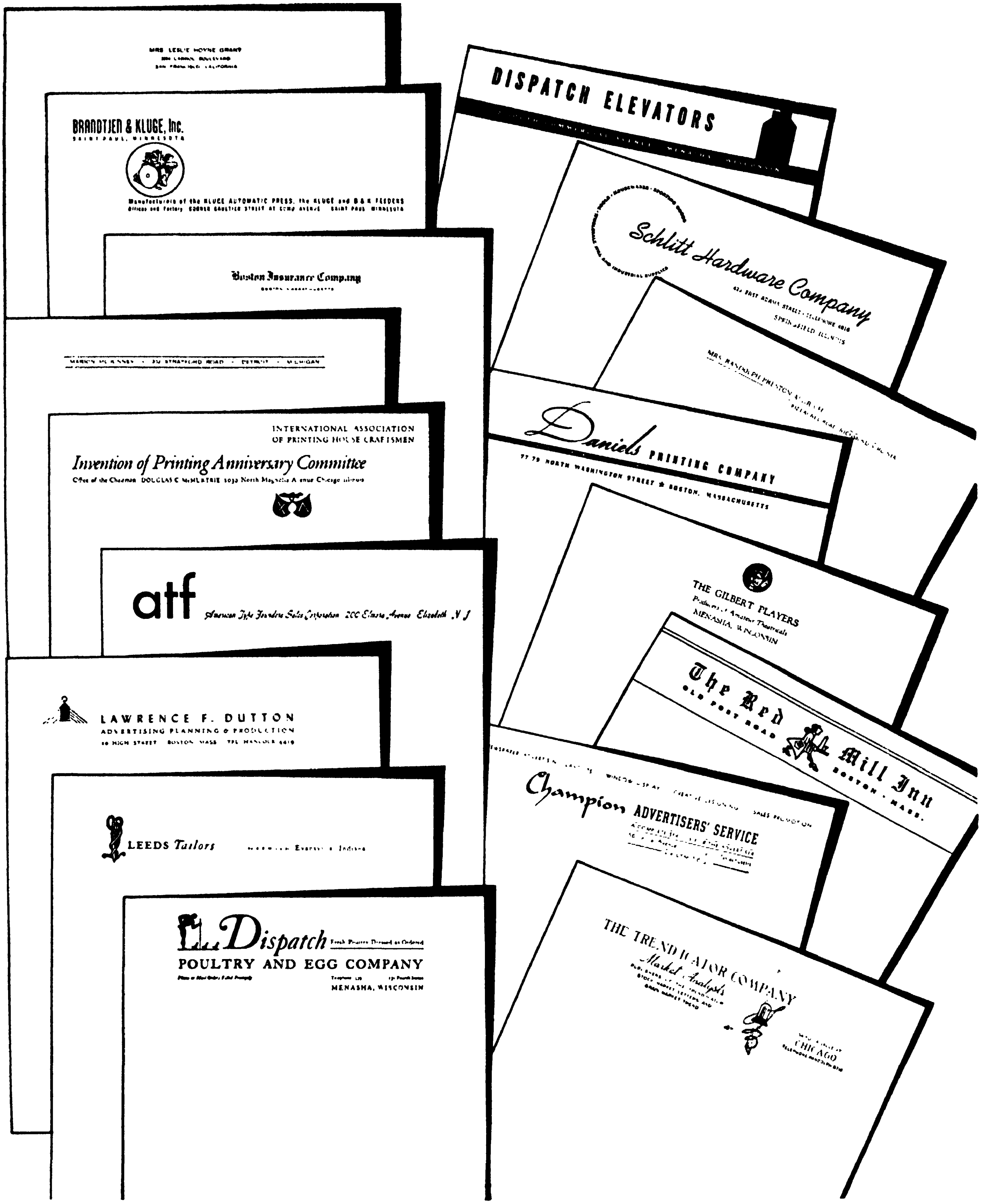
Job V

The composing stick, a case of type, leads, and slugs are used in setting cards.

Prepare a layout for your card. Set the composing stick to fit the longest line you are using. Business or professional cards should be set in Roman, Gothic, or Caslon type faces. Set the job, proof, and correct the errors. Lock up in a chase and print your cards on the press. Finally, clean and distribute the type.

LETTERHEADS

Most business concerns, professional people, and many private individuals have



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SAN FRANCISCO, CALIFORNIA

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MENASHA · WISCONSIN

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THE TRENDICATOR COMPANY
Market Analysts
PUBLISHERS OF THE TRENDICATOR STOCK MARKET LETTERS AND GRAIN MARKET TREND
CHICAGO

printed letterheads. These serve as a means of advertising and also eliminate the necessity of heading each letter by pen or on the typewriter. Many people judge individuals and businesses by their letterheads and the kind of paper used. Business letterheads usually contain the name of the concern, address, phone number, and the nature of the business. You will find it interesting to study those shown on page 30 to see how they are laid out.

You may wish to print some personal letterheads with your name and address on them. Several of the rules for printing calling cards will also apply here. The letterhead should be set in a type size that is not too large and should give the name, address, city, and state of the person using it. Telephone numbers and date lines will not be found on personal letterheads. A color of ink other than black sometimes makes the heading more impressive.

JOB VI

A case of type, composing stick, leads, and slugs are used on this job. Study the samples on page 30 and prepare a layout for your letterhead. After adjusting the composing stick to the proper length, set the job.

Proof and correct all errors. Lock in a chase and print the letterhead. Clean and distribute the type.

TICKETS

A ticket should be plain and will look best when set in several sizes of one type family. The title of the play or affair should be set in the largest type that is used on the ticket. The person or organization sponsoring the event should be the next size smaller. The rest of the information can be of still smaller type. Tickets appear best if some sort of border is used.

Borders and *ornaments* can be purchased to decorate a printed sheet so that it will be more pleasing to the eye. There are hundreds of designs made, and you can become more familiar with them by looking closely at advertisements in newspapers and magazines.

There is no special form or size for tickets; however, the usual size is between 2 x 3½ and 2½ x 4 inches. Instead of purchasing cards already cut, the printing industry generally cuts tickets from narrow pieces of lightweight cardboard that are scrap from some print job. Throwing such scrap away is costly over a long period of time.

Some tickets are printed with a seat stub attached to tell where the person is to sit. A perforation or series of cuts is placed between the ticket and stub so that it can be torn off easily. Perforations can be made in the press with a special sharp steel perforating rule which is a little higher than other rules. It slits the sheet so that it can be easily torn.

Most tickets are hand-set and printed in the smaller print shops. These small shops, where from one to a half-dozen persons are employed, are known as *job shops*. About 50 per cent of the print shops in the United States are of this kind.

SUMMARY

The platen, which is the most common press, takes its name from the large steel plate which forces the paper against the type to receive the imprint. After the press is inked, the form which has been locked in the chase is placed against the bed and fastened in place. The platen is then padded with the tympan to secure a more even and clear impression. A clear and even impression is the mark of a good pressman. Caution is necessary in feeding the press and removing the printed sheets in order to avoid injury. Offset and smudging are avoided by the care with which the sheets are handled. After the job is printed, the type and press should each be carefully cleaned and the type distributed to the case.

QUESTIONS

1. Where should the ink be applied on the disk when using a Gordon press?
2. What safety rule must be observed in oiling any machine?
3. What is offset? What are two ways in which it might occur?
4. What physical qualifications must a pressman have?
5. What is meant by straight composition?
6. What are the three "W's" for business cards?
7. How do you distribute a job after printing?
8. What are two things a printer can use in printing lines?
9. What are the two names for the usual school press?
10. A 4-em space is larger or smaller than a 3-em? A 5-em is larger or smaller than a 4-em?

TOPICS FOR DISCUSSION

1. Safety in the Print Shop.
2. How to Prepare a Gordon Press for Printing.
3. Applying for a Job in a Neighborhood Print Shop.
4. My First Experience Running a Press.

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CHAPTER IV

SOME METHODS OF MAKING TYPE

FOUNDRY TYPE

Early Type Makers

Let us travel backward in time for hundreds of years and imagine we are meeting the man who invented printing with movable type. Most people believe that about 1450 they would meet in Mainz, Germany, a man named Gutenberg. But no, we must go back even farther in years and in distance to China. Here we meet the Chinese blacksmith, Pi Shing, who lived about 1000 A.D.

Pi made his movable type with soft clay into which he carved the character and then baked or fired it. The firing turned the clay to a hard substance called *porcelain.* The porcelain type was assembled and then cemented with wax and resin into an iron frame. This form was inked and paper pressed against it to make a print. After enough copies were made, the cement was melted to loosen the type for another job. Pi Shing lived and printed his books with movable type nearly five hundred years before Gutenberg. However, these copies were not the excellent sheets of printing that you see today in even the cheapest newspapers, magazines, or catalogs.

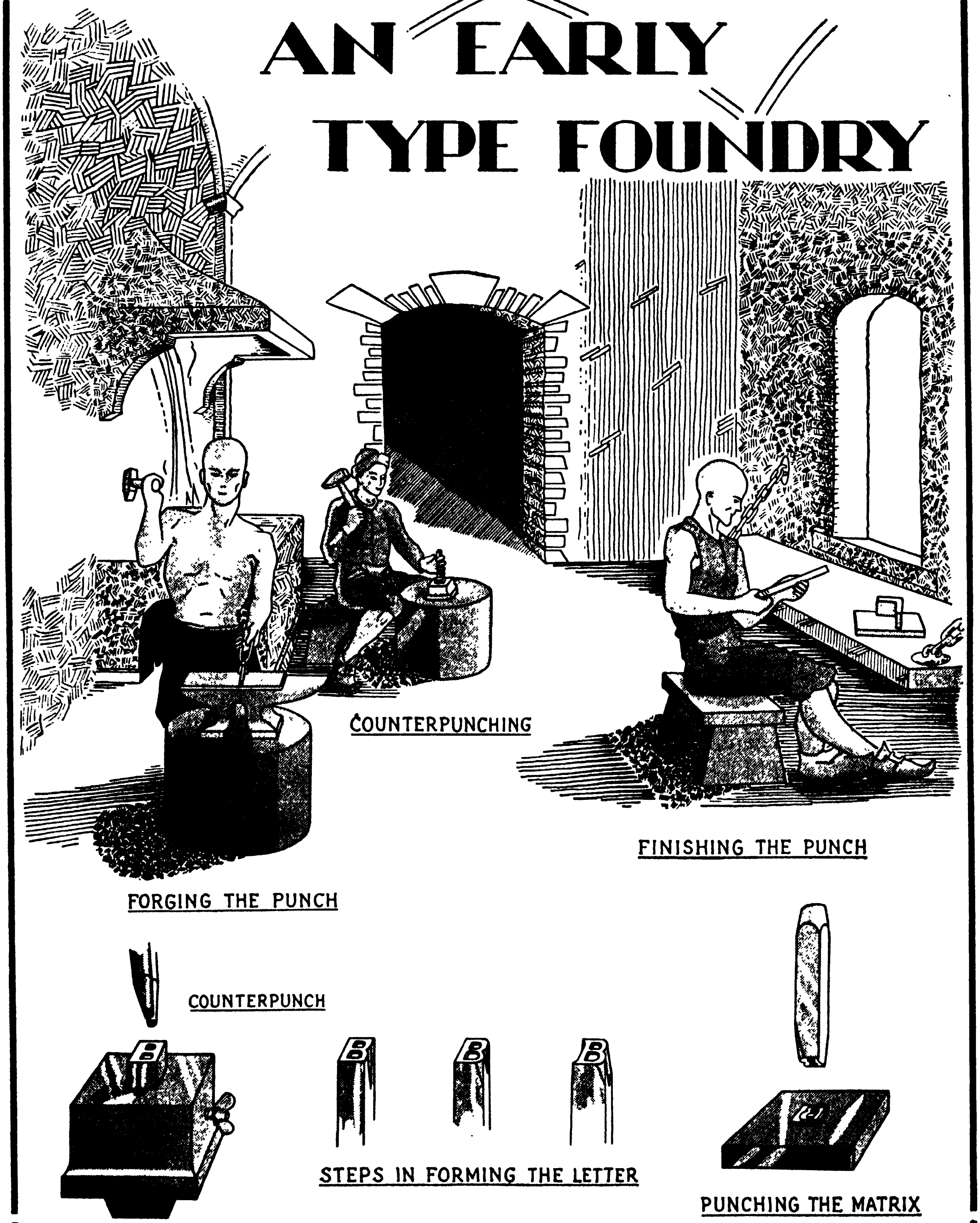
Several hundred years pass. In China, Japan, and Europe men are trying to use their skill and ingenuity to make a device by which they can record events more easily than by writing. In Mainz, Germany, we now meet Johannes Gutenberg.

Here, at last, is a man able to give the world movable *metal* type and a press for making the impressions. Research seems to show that the first metal type was made by inserting wooden molds in sand and pouring the molten metal into the hollow form after the mold had been removed from the sand. How little printed matter we would have today if this method were still used! Gutenberg made several improvements in his first method. Finally, he perfected a means of punching the letter into a brass form with a steel die and then pouring the molten metal into this form to cast the type.

Gutenberg's contribution to the world was to use the experiments of others as a basis for perfecting a method of making brass molds from which accurate type could be cast in quantities.

The methods of making type did not change much between 1460 and 1850, but after that time some remarkable discoveries and inventions took place. The laborious hand methods of cutting letters into steel were followed by machine-made forms. In the last fifty years man has made many wonderful advancements in all the graphic arts, particularly in the casting of type.

AN EARLY TYPE FOUNDRY



MODERN FOUNDRY METHODS

What a contrast modern type foundries are to those of earlier times! Inventors, machinists, and scientists have coöperated so that now we have a type foundry with row upon row of bright steel machines which are steadily and automatically casting foundry type as single characters that will be packaged and sold to printers. Foundry type costs about 60 cents to 70 cents a pound.

A type-casting machine is about the size of a teacher's desk. A smooth steel delivery table upon which the finished type is pushed, many rods and arms, a few adjusting wheels, and a massive steel body are what the visitor sees when entering a foundry. Back of the type caster is located the *crucible*, or melting pot, and there also is located the electric motor to run the mechanism.

Blocks of type metal are placed in the pot where they are melted by gas or electricity. When in a molten state, the metal is pumped into the brass form containing the letter or symbol. The type is trimmed to the correct size and height as it is pushed out of the machine.

Operators inspect the faces of the newly cast type for imperfections by using a small but powerful magnifying glass. Poor casts are remelted. For type up to 60 points the machines are automatic with a steady click, click, click as each letter is made. Smaller type is made faster than the larger sizes because the metal must cool. The caster can produce about 25 to 30 pieces a minute of 12-point type but only 4 or 5 a minute of 60-point.

When larger than 60-point type is cast, the operator uses a different machine and makes the single characters one at a time by hand. He removes and inspects each piece made in this way.

When lead is melted in an uncovered crucible a certain amount escapes as an invisible vapor which is injurious to the worker. He breathes these fumes and in a few years develops a serious illness known as *lead poisoning.* Most states protect the foundry workers by laws compelling the manufacturer to have large pipes cover the parts of the machines where these vapors are formed. A large fan draws the fumes away and forces them out of the building. Many foundries, however, have safety devices and conveniences that are above those required by law.

TYPE ALLOY METALS

Type metal consists of a mixture of several metals. Such a mixture when melted together is called an *alloy.* The metals and their proportions as used in foundry type are lead 69 per cent, antimony 19 per cent, and tin 12 per cent. Lead is used because it is a fairly cheap metal and has a low melting point. But, if it were used alone, the type would be too soft and would wear away quite soon. Most metals shrink slightly when they become cool. However, antimony is a metal that expands when it cools; so it makes the type fill each tiny part of the mold. Tin is very essential because it gives wearing qualities to the type.

There are many type faces each having its own special characteristics just as each individual's face is different from all others. Look closely at different printed materials, and you will see that the face of type used in a newspaper will not be the same as the face used in a book or a piece of advertising. Printers generally suggest a type face that is easy for the reader's eyes. On page 36 there are shown a few of the different type faces.

SPECIMENS OF A FEW TYPE FACES

When ordering

Set in 24 point Cooper Black

type, be sure to give

Set in 18 point Cooper Black

the following information: point

Set in 12 point Cooper Black

size, name, and number of pounds re-

Set in 10 point Cooper Black

quired. All type should be ordered from the latest

Set in 8 point Cooper Black

When ordering type,

Set in 24 point Bodoni

be sure to give the following

Set in 18 point Bodoni

information: point size, name, and number

Set in 12 point Bodoni

of pounds required. All type should be ordered

Set in 10 point Bodoni

from the latest catalog sent you. When ordering type, be

Set in 8 point Bodoni

When ordering type, be sure

Set in 24 point English Caslon Italic

to give the following information:

Set in 18 point English Caslon Italic

point size, name, and number of pounds required.

Set in 12 point English Caslon Italic

All type should be ordered from the latest catalog sent you.

Set in 10 point English Caslon Italic

When ordering type, be sure to give the following information: point size,

Set in 8 point English Caslon Italic

When ordering type, be sure to give the

Set in 18 point Stationers Semi Script

following information: point size, name, and number of

Set in 12 point Stationers Semi Script

When ordering type, be

Set in 24 point Old English

sure to give the following in-

Set in 18 point Old English

formation: point size, name, and number of

Set in 12 point Old English

pounds required. All type should be ordered from

Set in 10 point Old English

the latest catalog sent you. When ordering type, be sure to

Set in 8 point Old English

When ordering type,

Set in 24 point Goudy Handtooled

be sure to give the following

Set in 18 point Goudy Handtooled

information: point size, name, and num-

Set in 12 point Goudy Handtooled

ber of pounds required. All type should be

Set in 10 point Goudy Handtooled

Printer's type is grouped into families, and each family has small, medium, and large sizes. All faces in each family are of the same design so that the printer can use any size he needs in any family.

MACHINE-SET TYPE

There are two ways to assemble type for printing. You have set type by hand. The other method is to have the work done on a type-casting machine. There are different machines doing this work each possessing individual features.

The Linotype

The linotype is one of the most widely used typesetting machines. It has four main parts: keyboard, magazine, casting machinery, and distributing machinery. The keyboard is located in front of the machine and controls the *matrices*, or brass letter forms, that are used for casting each

Courtesy Conkey Company

A BATTERY OF LINOTYPE MACHINES

letter. This board is about twice the size of a typewriter keyboard but shaped and operated much like the typewriter. When a key is touched, a brass matrix with the letter sunk in the front surface falls down a tube into a little channel to the left of the operator. Letters and spaces fall into place until the line is almost full. A bell rings to warn that only a letter or two can still go in the channel. The operator pulls a lever and the hot pot of molten type metal from the casting machine is automatically brought near the line of matrices. This metal is softer than that used in foundry type. It is made by using more lead. A wheel turns over and the liquid metal is forced against the line of letters which the operator had the machine deliver to the channel. Again a wheel revolves, a rod pushes forward, and a complete line of type slides into the galley or metal tray. This line is cast in one piece ready to be put into the press for printing. After machine type has been used for printing, it is melted and cast again.

After the line of type is delivered, a long steel rod or arm moves down on the left side of the machine, grasps the matrices, separates the letters from the spaces, and hooks the letters on a notched bar located at the top and in the rear of the machine. On this rod the matrices are moved along to their proper place and dropped into the magazine or storage tray until wanted again. A clever device, indeed, a machine that will deliver correct letters with the touch of a button or key, cast the line of type, and return the letters to their correct places!

The linotype machine is almost human in operation. If something goes wrong while the machine is working, automatic devices stop it at once. When this occurs in a shop where there are several linotype machines, a special machinist is called to do the repairing. In smaller shops and in towns too small to have a linotype mechanic, the operator must do his own repairing. The machine costs from $4000 to $11,000. It does work equal to that done by five hand compositors in producing about 9000 characters an hour.

Operators must be skilled to use this complex machine. Some companies pay the operator by the amount of work that he can produce in a day. In the larger towns most of the operators receive their pay by the hour. They are paid from about $1.50 an hour to $2.00 for nightwork.

Qualifications for a linotype operator are sound physical health, ability to think quickly, good knowledge of English and grammar, good eyesight, steady nerves, and good work habits. Most operators are men, but some women are employed in that capacity. In linotype operation there are, of course, advantages and disadvantages. The advantages are steady employment, adequate salary, and the chance to advance to an executive position. The disadvantages are the presence of lead vapors, high-speed work, lack of sunshine, and few jobs in most of the smaller towns.

The Monotype

Monotype machines cast lines of type as single characters for *letterpress* printing, which means printing from type. These machines are in two units. One unit is the keyboard; the other the casting, or typemaking, part. This machine was invented later than the linotype and much of the work done today is with the monotype.

Work is begun on the keyboard unit. This part looks similar to the keyboard of a typewriter, only it is about four times as large. A roll of paper about five inches wide is fed through the machine and small round holes are punched in this paper when the keys are pressed. When completed, the paper resembles a player-piano roll, only it is not as wide. No spacing is needed because this is done automatically by the machine.

The casting machine is about the size of a teacher's desk but a little higher. The roll of paper is fed into this machine, and the proper die for casting the letter is automatically selected by a series of levers powered by compressed air. The matrices, or type molds, are contained in a small steel frame about five inches square. This frame is clamped to the top of the monotype machine and is shifted mechanically so that the correct letter is under the molten metal. This molten metal is forced into the matrix, or die, and the letter formed. It is pushed out in a line onto a galley.

Because single letters are cast, corrections can be made the same as in hand-set type. Perhaps it takes longer to learn to operate the monotype; but it is said that, after this learning has been accomplished, it is easier to run than some other typecasting machines.

The machine produces about 9000 characters an hour when medium sized type is being made. The monotype costs about $6000.

The Ludlow

The Ludlow is a type-casting machine used for setting larger sized type such as is found in grocery store handbills. The type is cast in complete lines similar to those of the linotype.

Again we have a machine that uses matrices for the casting. The operator has the characters in a special type case. He sets his work by hand, picking up several characters at a time. They are placed in a special stick to form the words he wants. When the stick is filled, it is placed on the casting machine where the molten type metal is pumped against the line of matrices. In a few seconds the machine pushes out the words cast on one solid line. As soon as the line has been cast, the matrices are put back into the case by hand.

An average operator can set and cast a line a minute; and, when he desires the machine to repeat the same line for several copies, he can secure five or six lines in a minute.

The machine is a simple one, being quite free of wheels, gears, and rods. It is about two and one-half feet by three and one-half feet in size and is about as high as a table. There is practically no noise when the machine is operated.

The Ludlow is one of the easiest of the type-casting machines to learn how to run. The type is set by hand; and the matrices, or molds, have the characters stamped on the top surface as they would appear when printed. The reverse mold is on the bottom side, but the man who sets the type never looks at that side. It is said that any person who knows how to read and use the alphabet can operate this machine. The Ludlow and necessary equipment cost about $2300.

When much small type is to be cast, as in the pages of a book, it is best to use either a linotype or monotype.

SUMMARY

Pi Shing, Chinese blacksmith, is credited with the invention of printing by means of movable type. His characters were baked from clay to form porcelain and were cemented into a frame for printing. Gutenberg's brass molds from which metal type could be made are the greatest single contribution to printing. The modern type foundry makes its type from molds just as did Gutenberg. However, vastly larger quantities, as much as 1800 pieces an hour, are possible because of modern machinery. The type metal used for foundry type is an alloy designed to be fairly cheap, lasting, and at the same time, capable of filling all the spaces of the mold. Type faces are of many kinds, each designed to best serve a particular need. Type is both cast and set by the modern linotype, monotype, and Ludlow machines. Without these inventions the great amount of printed matter produced today would be impossible.

QUESTIONS

1. In what way was Johannes Gutenberg's work valuable to mankind?
2. If foundry type costs 60 cents a pound and a printer orders 1260 pounds how much would he have to pay for it?
3. If he paid the bill in ten days, or sooner, the printer could receive a 2 per cent discount. How much would he save by paying the bill at the time of delivery?
4. What race of people are credited with doing the first printing?
5. Why do states require protection for factory workers?
6. What three metals are used to make foundry type and why is each used?
7. How does the finished type from a linotype differ from that of a monotype?
8. How should workers guard against lead poisoning?
9. What qualities must a person possess to become a successful linotype operator?
10. What must be done to the lines of type for printing after they have been made on the linotype?

TOPICS FOR DISCUSSION

1. The Reasons for Using Alloys in Type Metals.
2. How Pi Shing Made and Printed His Type.
3. The Life of Johannes Gutenberg.

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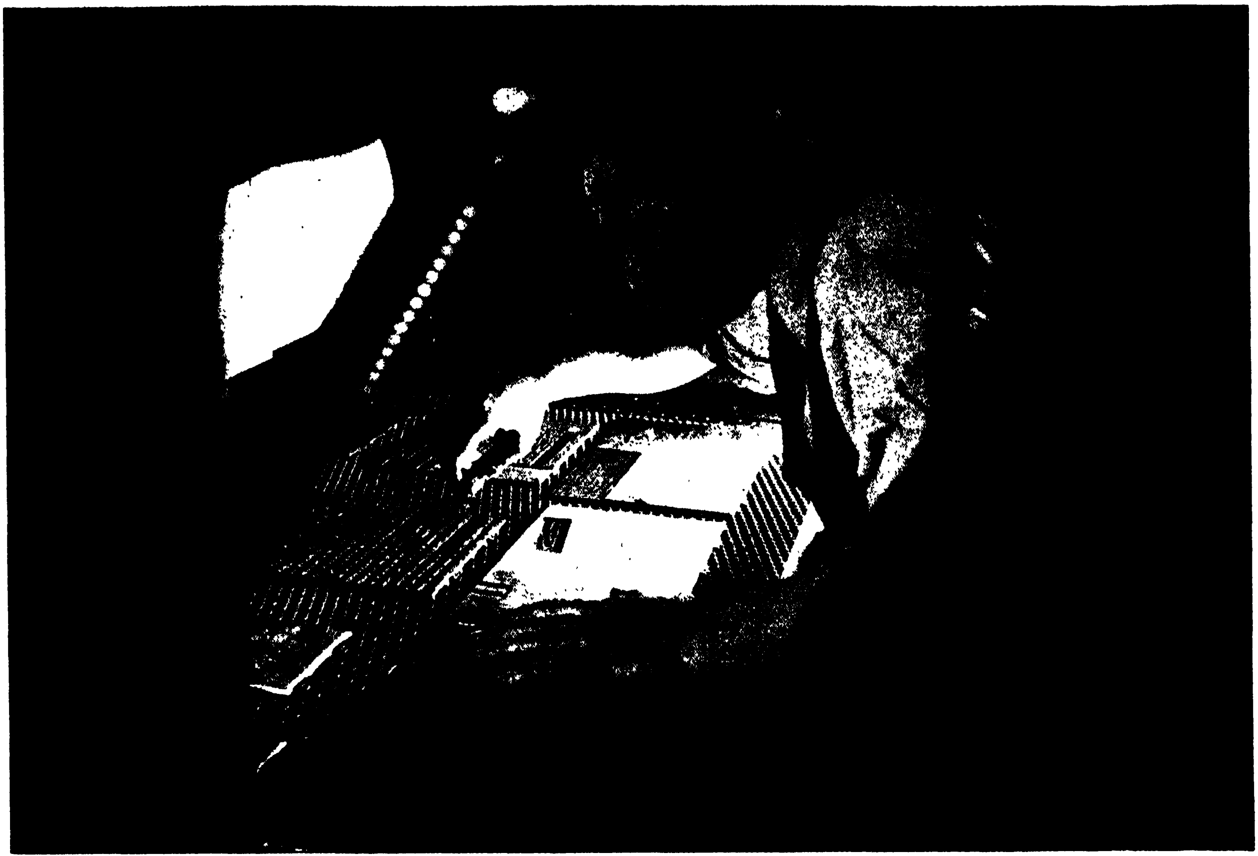

Courtesy Miehle Company

PLATES ARE QUICKLY AND EASILY LOCKED ON HONEYCOMB BASES

CHAPTER V

HIGH-SPEED PRESSES

THE CYLINDER PRESS

Great changes have taken place since man has applied science to machines. He has been able to design and build high-speed printing presses that do an excellent job of reproduction at the almost unbelievable rate of from 2000 to 50,000 copies an hour in contrast to the production of early times.

The early printing press was made of two heavy upright timbers with connecting crosspieces at the top and bottom. A cross timber was placed at the center. Below this was the support for the form of type; through the center timber was passed a large wooden screw with the lower end fastened to the center of a wooden platen. This screw was tightened by means of a bar passed through a hole at the bottom. The first press used by Gutenberg was no doubt of this kind. With this kind of press a workman could make about 300 copies, called *pulls*, in a working day. What slow work it was to print the large many-paged books of these early printers! Several changes were made by inventors and a

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CYLINDER PRESSES IN THE PRESSROOM

better machine was perfected. One of these is known as the Franklin Press and is shown on page 21.

Modern presses are grouped into three classes—platen, cylinder, or flat-bed, and rotary. The platen press was described in Chapter III and is used for printing the smaller sheets.

In shops where larger sheets are to be handled, we find another press, the cylinder. This is what the name suggests—a large cylinder that revolves and presses the paper in a rolling motion against the flat type form. The type is inked by the roller and slides back and forth under the cylinder. This machine prints large sheets of paper that come in flat, rectangular packages. Many of these presses are equipped with automatic feeding devices. Cylinder presses are used for most book printing and fine color work.

There are four types or designs of cylinder presses. One is called the *drum* press. It has a large metal cylinder or barrel-like drum upon which the paper is placed. The type slides back and forth under it and when the paper is carried below to the type it is printed. This drum makes only one revolution for each printed sheet. It is fed either by a man or an automatic device.

A second press is known as the *two-revolution* type because the cylinder makes two revolutions for each print. It is the kind used most often. The third type is called the *stop* cylinder because the cylinder stops for a moment to allow the type to be returned below it for the next print. The *perfecting* press is the fourth kind. It prints both sides of the paper at the same time.

One manufacturer says that his cylinder press weighs 19,500 pounds. It is 22 feet long, 8½ feet wide, and 8½ feet high including the delivery table. This press prints sheets of paper from 11″ x 17″ to 28″ x 40″ at the rate of 3000 sheets an hour. Such a press costs about $10,500. A large one weighs 33,000 pounds and costs up to $25,000 with all special equipment.

The boy who wishes to operate one of these presses starts by working three years as a junior feeder and is paid $15 a week with a small increase every few months. Beginners are accepted at about eighteen years of age, and high-school graduates are preferred. The next promotion is to an apprentice pressman and this work is paid 75 cents an hour at the start. The boy works for two years at this rate securing automatic raises and then becomes a feeder. Feeders are paid about $1.15 an hour. They in turn are promoted to pressmen who can earn $1.35 to $1.50 an hour. The wage depends upon the size of the machine the man operates and the town in which he works.

Of course, the junior feeder does such work as oiling and cleaning machinery, washing the rollers, adding paper to be printed, and watching the auomatic feeds. The feeder adjusts, feeds, and watches the ink on the printed paper. Some large cylinder presses need two feeders.

The pressman gets the correct form on the press, sets the guides, places the correct amount of packing on the cylinder, and gives the final proof his O. K. He examines many parts of the final proof with a magnifying glass to see whether the plates print perfectly. He also mixes the inks for the proper colors, which is a difficult task.

Men working in this division of the graphic arts industry enjoy their labor because they like to work around machinery. The work is inside and steady with good pay. However, inside work is not desirable for some people as it affects their health. Because the printer often works all day under electric lights, his eyes must be strong. Although the machines are well protected, there are chances for accidents. You must have good eyes, the full use of both arms and legs, and good health to do this work.

THE ROTARY PRESS

The rotary press is used in modern printing plants where thousands upon thousands of copies are expected. This is the fastest and largest press man has so far perfected. It is really a group of presses in a row. They are arranged so that they may be connected into one huge press or a few of the single units run at one time. They are used mainly for newspaper, magazine, and large telephone directory work.

Huge rolls of paper that weigh 1800 pounds and are from four to five miles long are threaded through the press as one continuous ribbon. The paper is printed on both surfaces as it passes through. After it has been printed, the paper passes through a folding device and then is cut to the correct length. The sheets now go to a device that carries them away fcr binding, packaging, and mailing.

The type for this press is cast with type metal in a half cylinder about thirty inches wide and is known as a *stereotype*, or *stereo*.

Courtesy Goss Printing Press Company

PLACING A STEREOTYPE ON THE ROTARY PRESS

To make this stereo the type is set by machine and by hand. The type together with the engravings is then locked flat in a chase. Blotterlike paper is placed above it, and the whole thing is slid into a machine that presses the soft pad of paper against the form. Heat is applied and then both stereo and form are taken from the machine.

The paper, brown and crisp from heat and pressure, is now nearly as tough as a piece of tin and about one eighth of an inch thick. It is called a *matrix,* which means a form for casting or duplicating. This matrix is placed in a semicircular machine, and hot type metal is forced against it. When it cools, the semicircular plate is placed on the cylinder of the press.

You may gain some idea of the terrific speed at which inventors have been able to make these presses run when told that a Chicago newspaper operates its rotary presses at the rate of 50,000 newspapers an hour.

One printing unit takes months to plan by expert machinery designers. Many more months are needed to build the unit. Each costs about $20,000 and a press is made up of from four to a dozen or more units.

One Chicago newspaper has 110 units made into seven presses. They are not always all running at the same time. If a paper of sixteen pages is put out, only a few units will be working. An edition of sixty-four pages will require that more units be put in motion. From four to eight skilled men are required to operate such a press. The number of men working depends upon the number of units being operated at the time.

The qualifications for men working with rotary, or *web*, presses, as they are called, are about the same as for those who operate cylinder presses. The method of entering this branch of work, however, is a little different. In a printing plant of any size helpers and errand boys are employed and are called *flyboys*. Apprentices are selected from these boys. Two things determine which boy the print-shop foreman selects to learn the printing trade. The first is the boy's efficiency and the second the length of his service as flyboy. Work habits are worth more than the length of employment. After five years as an apprentice, the boy is eligible for a job as a journeyman or pressman.

Offset Printing

This is the newest development of printing by rotary press. The process is to print from metal plates onto a soft rubber blanket which has been placed over a steel roller. The blank paper is fed between a steel roller and the inked rubber. The ink transfers from the rubber blanket to the paper. This type of printing is said to produce copies of a softer tone than those printed directly from the metal plates.

Offset printing was discovered by accident. A Chicago pressman was operating a rotary press. A sheet of paper missed going through the machine and the plates printed on a soft rubber blanket that was part of the tympan on the cylinder where the paper should have been. The pressman forgot to clean the ink from the rubber and when the next sheet came through the press it had received the inked imprint from the rubber. Through this accident a new process was discovered.

PRINTING CENTERS

Much of today's printing is done in large industrial centers because manufacturers and business houses use a large share of all printed matter. New York City and Chicago are the two main graphic arts centers in the United States. In these cities large quantities of printing are produced in plants employing thousands of skilled workers. However, for better working and living conditions, some companies are moving their plants into the semirural communities.

Most of the printed matter of this country is produced in a few large plants where many people are employed. The large companies can print their work more easily and cheaply than a small plant because of the amount of money and modern machinery they possess. However, about one half of the print shops are known as one-man shops. This is the business where one man does all the work needed for printing. Ambitious individuals may start their own business with little money in such a shop.

Trips

Much valuable information can be gained from taking a trip through a printing establishment. You will find such trips both interesting and educational. After having secured some information about the graphic arts in school, see whether you cannot help your instructor to arrange such a trip.

Do not think you must go to the largest print shop. Often things are done in such a fast and complicated manner in the large shop that you will miss much. A small neighborhood shop will prove just as interesting and often the owner will have time to show and explain all the operations to you.

SUMMARY

Daily newspaper circulations in excess of 1,000,000 copies would be impossible without the development of modern high-speed presses. The larger newspapers owe their very existence to rotary presses, some of which are capable of producing as many as 50,000 copies an hour. Paper for this press is a continuous roll several miles in length that is printed on both sides, folded, and cut. The material to be reproduced on the rotary press is in the form of a curved stereotype made from a matrix. Large flat sheets of paper that could not be handled on the platen press are printed on a cylinder press. Some of these presses can print both sides of the sheet at the same time. A recent discovery of the printing trade is the method of offset printing from the plates to a rubber blanket which gives the imprint to the paper.

QUESTIONS

1. How many pulls could be made in a day by the early printer?

2. Large rectangular sheets of paper are printed on what kind of press?

3. About how many sheets an hour can a cylinder press print?

4. At about what age are boys given employment in print shops?

5. If a boy receives 75 cents an hour from his employer in a print shop and he works 7½ hours each day for 5 days, what would his pay be?

6. How can you tell a rotary press from a cylinder press?

7. What is a matrix?

8. What is meant by offset printing?

9. What cities in the United States lead in the production of printed matter?

TOPICS FOR DISCUSSION

1. Printing in the American Colonies.
2. Our Neighborhood Print Shop.
3. Old and Modern Presses.

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CHAPTER VI

MAKING LINOLEUM ENGRAVINGS

Linoleum-block printing is an easy method of producing illustrations. You do not have to be an artist or gifted craftsman to make a good engraving. Thought and care when performing the different steps are all that is necessary. Block prints may be used for making posters, greeting cards, prints for cloth, illustrations, book covers, tickets, prints for framing, monograms, programs, bookplates, place cards, and bookmarks.

THE LINOLEUM BLOCK

Preparing the Surface

The linoleum used for block printing should be of good quality with a smooth surface and fine texture. The thickness should be about one-fourth inch, and the piece should be one color without pattern. The wax should be removed because waxed linoleum is difficult to handle and will not take the carbon tracing or printing ink. Any kitchen scouring powder, water, and cloth will remove this oil or wax. You may saturate a cloth with benzine or gasoline and scrub the surface until it has a dull appearance.

After the wax is removed, rub a chalk-filled blackboard eraser over the linoleum in a circular motion. The chalk dust helps to show the lines of the traced design. Some people prefer to cover the surface with a diluted white poster paint so that the lines of the design will stand out. Do not get the paint too thick, or it will crack and chip off.

In cold weather or when it is old, linoleum becomes hard and will crack easily. This can be prevented by warming the linoleum to make it flexible and permit easier cutting.

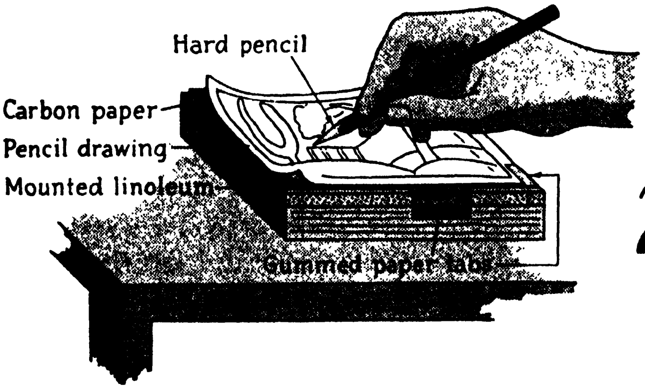
Transferring the Design

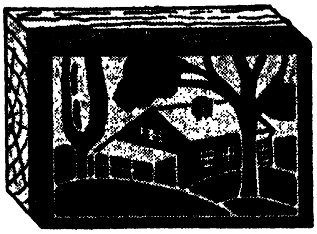
The design should be drawn on ordinary paper and a copy made on thin transfer or tracing paper. This tracing is done with a sharp, medium-hard pencil so that the lines are fine but clear. In order to have the design or lettering appear when printed in the same position as the original, it is necessary to *reverse* the drawing before tracing it on the linoleum. To reverse a drawing, put the tracing paper on the windowpane with the blank surface toward you and draw over the lines as you see them on the reverse side. Transfer the drawing to the linoleum by placing a sheet of carbon paper between the tracing and the block having the reverse side of the design *up*. Use a sharp hard pencil so the lines will not appear too wide on the block. This is shown in step 1 on page 48. To prevent slipping, have a friend hold the design while you trace. Tape may be used to hold the drawing and the carbon paper in place.

LINOLEUM ENGRAVING

CUTTING THE BLOCK

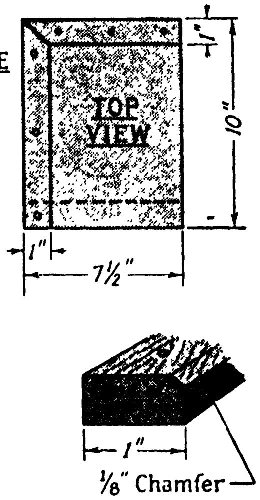
1. TRANSFER THE DESIGN TO THE LINOLEUM



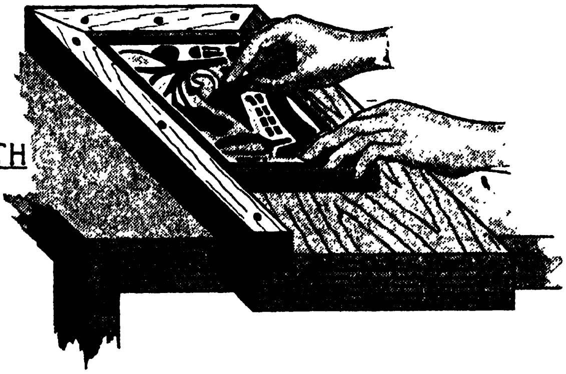


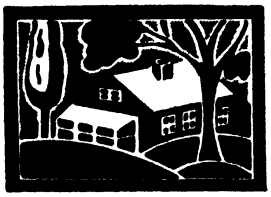
2. INK THE SURFACES TO REMAIN FOR PRINTING

SKETCHES OF THE HOLDING JIG

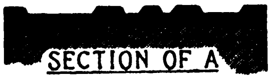


3. PLACE THE BLOCK IN A HOLDING JIG AND CUT THE OUTLINES OF THE DESIGN WITH A CUTTING TOOL (USE KNIFE OR VEINER)



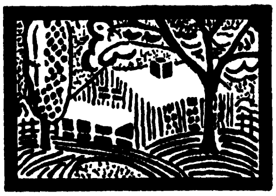


4. ROUT OUT LARGE BACKGROUND AREAS (USE GOUGE)



SECTION OF A WELL-CUT BLOCK

TOOL SHAPES



5. ADD DETAILS TO GIVE CHARACTER TO PRINT (USE GOUGE OR VEINER)

Check your tracing on the block and touch up the design where necessary. To prevent rubbing the tracing off the block, the lines may be inked. Ink in the areas which print and leave the portions which are to be cut away the natural color of the linoleum to avoid mistakes in cutting. This is shown in step 2.

Some people prefer to trace the design on thin paper and glue this to the surface of the linoleum, allowing the glue to dry overnight. They then cut through the paper and into the block. The disadvantage of this is that the paper on which the design is shown is cut away and you do not have the copy to check the engraving on the block.

TOOLS USED FOR ENGRAVING

The standard set of linoleum-engraving tools consists of five, each with a different shape and designed for certain kinds of work. The small *U-shaped veiner* is used for outlining and detailing. It is considered the most valuable tool in the set. The *V-shaped veiner* may be used to outline small work and for fine lines and delicate cutting. The *small gouge* is used for cleaning out and routing after the outline is completed. For larger surfaces use the *large gouge*. The *knife* is used for making long straight cuts and for getting into small corners.

Page 50 shows the shape of the cutting edge of these tools. You may make your own set without much trouble or expense. Razor blades, penknives, stencil knives, chisels, gouges, and even paring knives work well for cutters.

A Homemade Linoleum Cutter

Discarded umbrella ribs, some round wood for a handle, and sandpaper are the only materials you need to make a linoleum cutter. A triangular file, some small drills, a hand drill, grinder, whetstone, wood file, and a ruler will be used to shape this cutter. Be sure to read all instructions before beginning work. Cut a piece of rib about 3″ long from an old umbrella for the cutter. This can be done by filing a small nick in the rounded surface of the rib and completing the break with the fingers. There are two sizes of ribs in umbrellas. This will give you two shapes for carving tools.

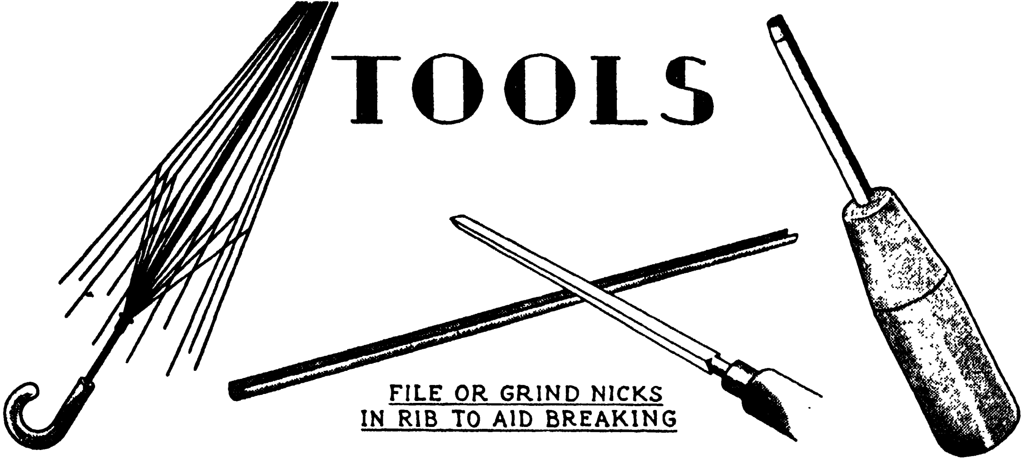
Prepare a wooden handle 2½″ long and about 1″ in diameter. Be sure that the end that fits the palm of the hand is completely rounded and sanded so that no blisters are made when carving. This handle may be shaped in a turning lathe, or it can be made with hand tools. See page 50. Bore a hole in the small end of the handle just a little smaller than the size of the cutter so that it will have to be forced about 1¼″ into the handle. Drive the handle onto the cutter.

With a grindstone or file sharpen the end of the cutter. Finish the edge on an oilstone. Notice the right and wrong methods of sharpening as shown on page 50. Keeping the tool sharp is important in producing lines of uniform depth and clean edges. Dull tools produce lines with ragged edges and are difficult to control. They often cause slipping and ruin the cut. Linoleum has a tendency to dull cutters quickly. Better work can be done more easily and quickly if you take time to sharpen the tools often. Ask your instructor to show you how to hone the tools.

Holding the Tools

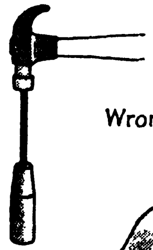
For most work the tools are held in the palm of the hand with the first finger near the cutting edge to steady and guide the tool. This allows much pressure to be applied and makes it possible to cut deeply into the linoleum. This method is used to cut heavy lines, to make deep cuts, to rout

SIMPLE LINOLEUM TOOLS

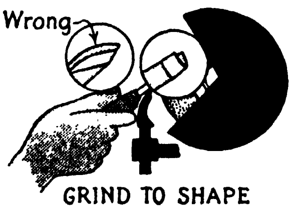


FILE OR GRIND NICKS IN RIB TO AID BREAKING

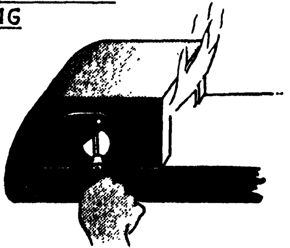
7/8" DOWEL FOR HANDLE 3" LONG



DRIVE RIB INTO DRILLED DOWEL

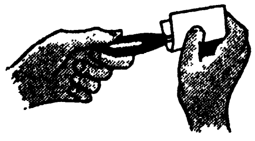


GRIND TO SHAPE

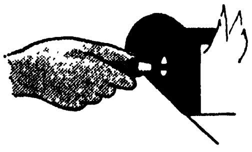


HEAT BRIGHT RED

COOL IN WATER TO HARDEN

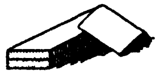


POLISH BRIGHT WITH EMERY



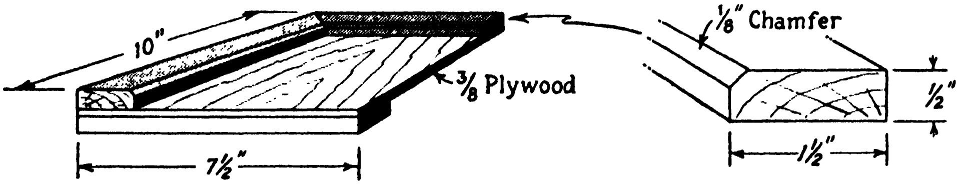
HEAT CAREFULLY WATCH COLORS - CONTINUE HEATING TILL DARK BROWN COLOR APPEARS

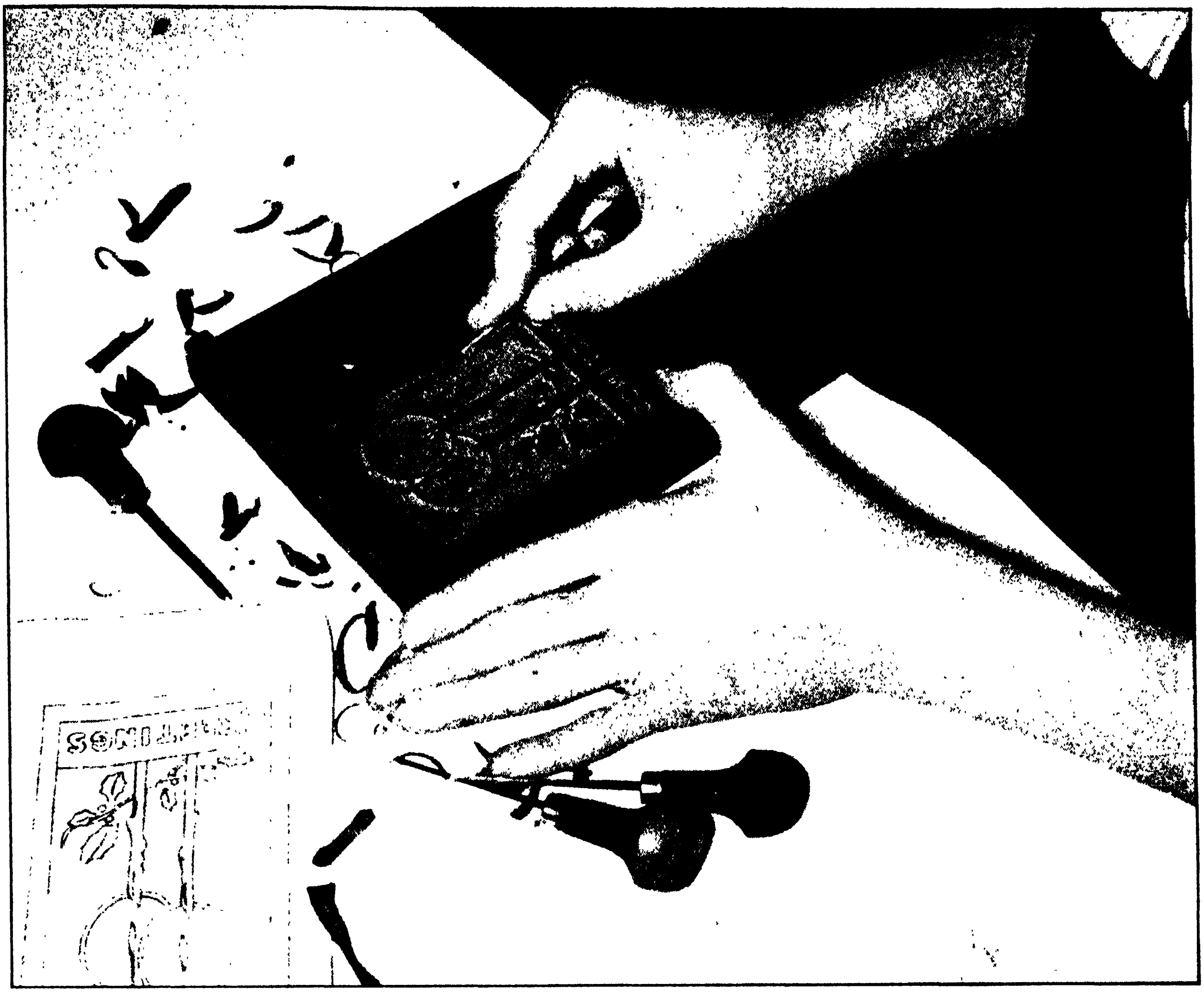
COOL IN WATER



SHARPEN WITH ROUND AND FLAT OIL STONES

LINOLEUM BLOCK HOLDER





USING A JIG TO HOLD THE BLOCK

out sections which are not to print, and to do large pieces of work.

To cut fine-line work which is not to be deep hold the tool as you would a pencil. This does not permit much pressure but allows freedom in handling. Use this method for detailing, outlining, small lines, and sketching.

Always cut away from yourself. This permits better control. Hold the block with the block holder as shown in step 3 on page 48. Turn the block when necessary to cut curved lines or to get into corners. The tools are held so that they will not dig too deeply below the surface and cause large chips or cracks to form in the linoleum.

ENGRAVING THE BLOCK

You will use the linoleum block with your drawing on it, linoleum or printer's ink, paper for proofs, gasoline or benzine, and a wiping cloth. The tools needed are a holding jig, brayer or roller, ink slab, linoleum cutters, and a type brush.

Determine the method of treatment you wish to use for your design. There are five principal treatments that may be used. The first is to cut the block so that the subject is left solid and the background is cut away. This will reproduce the design in silhouette, black with the background in white. You may cut away the subject. This will print the design in white and the background in black. Cutting the subject and background in single lines gives a print with white lines on a black surface. The fourth treatment is to outline the subject. This produces a print in which the design is in lines and the background is white. The subject in outline with a decorative background is the fifth treatment you may wish to use. This produces an effect in which the design is in lines with a background of fine black and white lines.

Outline the design with a small V-shaped veiner. This must be done carefully and with a steady hand. Any mistakes or slips of the tool will show when the print is reproduced. Study step 3 on page 48.

When outlined, take the medium-size gouge and remove the parts that are to be cut away. If the area to be removed is large, use the larger-size gouge. The linoleum should be removed to a depth of a little more than one-half the thickness of the block. Do not cut down to the burlap as this weakens the block. Rough out extra material from the solid areas toward the center of the section being removed. All routing must be deep enough to keep the nonprinting areas from showing on the paper. In cutting around an edge of the design, be sure the edge is beveled to give the printing surface more strength and permit longer use. See page 48. The outer sides of the block are cut vertically and not beveled.

Cut outside and not directly on the traced lines if they are to show width. Never cut deeper than the upper edge of the cutting tool. Straight lines should be cut with a steady forward movement. Do not cut with short strokes as each stop will show on the print. In carving corners or small squares, a separate stroke is made for each side. It is best to cut outward from the corner and away from the design. Always turn the block when it is necessary to cut in a different direction from that just used. To cut curved lines, revolve the block with the free hand and guide the tool with the other. The deeper the tool is made to cut, the wider will be the groove in the block. Wide cuts make it easier for mistakes to occur. When the print is completed, test the corners of the linoleum with the try square. If necessary use a knife or razor blade to make the block square.

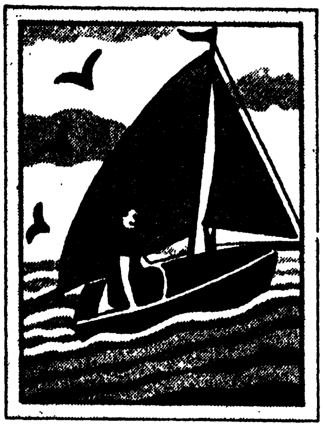
Take a proof of the cut on the proof press and check it with the original drawing. Be sure to clean the ink from the block before making corrections. If some of the lines are too thick, the edges ragged, or the open spaces not carved deeply enough, the block is retouched and a new proof taken. This operation should be repeated until the print is satisfactory.

Blocks for Color Printing

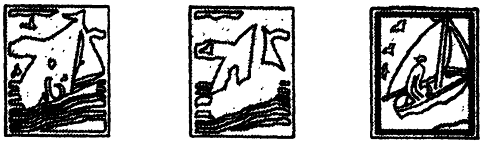
Designs may be printed in colors as well as in black and white. A color sketch the exact size of the print you wish to make should first be made. A separate block is cut for each color that is wanted. Only the parts which are to be printed in that particular color are left on the block.

Page 53 shows a set of blocks that will print a picture in three colors. The upper blocks are marked with the design, and the lower are the same blocks with the background cut away. Each block must be cut so that its color will print, *register*, without overlapping. Much trimming is necessary so that the colors will meet at the correct places. In color printing the block which has the outline of the sketch is called the *key block*. It is to this that all the others must be made to register.

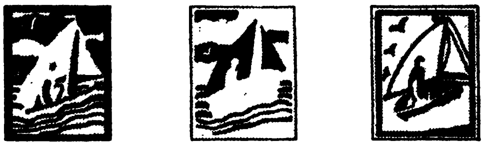
MULTICOLOR BLOCK PRINTING



1. MAKE A COLOR SKETCH THE EXACT SIZE OF PRINT



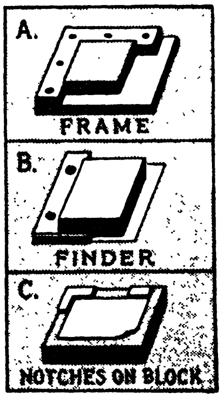
2. CAREFULLY TRACE OUTLINES OF EACH COLOR ON SEPARATE BLOCKS



3. GOUGE OUT BACKGROUND AREAS FROM EACH BLOCK

4. INK THE LIGHTEST COLOR BLOCK; PLACE IT IN COLOR PRINTING PRESS; PRINT

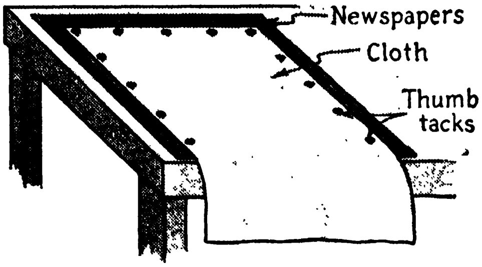
DEVICES FOR REGISTERING THE BLOCK IN MULTICOLOR WORK WHEN COLOR PRESS IS NOT USED



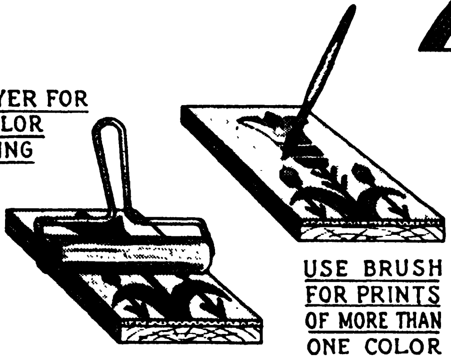
5. REPEAT THE PROCESS UNTIL ALL THE COLORS HAVE BEEN PRINTED

TEXTILE PRINTING

1. CUT THE BLOCK DEEPLY BY THE USUAL METHOD



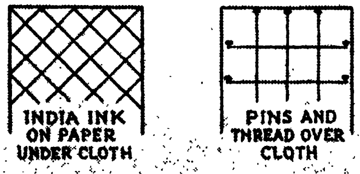
2. ATTACH CLOTH FIRMLY TO THE BOARD OVER A PAD OF NEWSPAPERS



USE BRAYER FOR ONE-COLOR PRINTING

USE BRUSH FOR PRINTS OF MORE THAN ONE COLOR

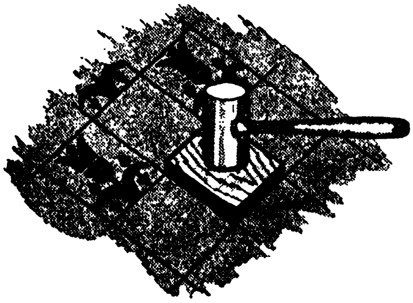
3. INK THE BLOCK



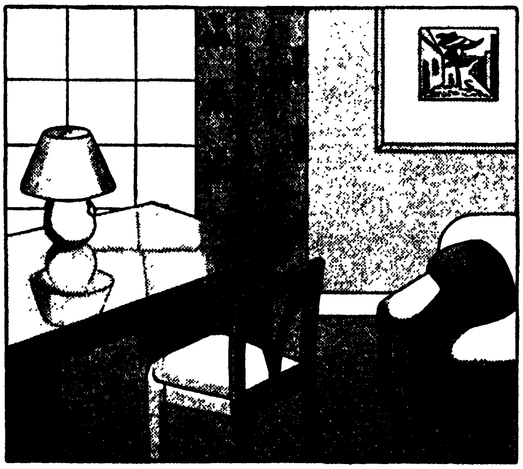
INDIA INK ON PAPER UNDER CLOTH

PINS AND THREAD OVER CLOTH

METHODS FOR PLANNING ALL-OVER PATTERNS



4. PLACE THE BLOCK IN THE DESIRED SPACE; APPLY PRESSURE WITH THE HAND OR MALLET



Three devices to help in registering the blocks are shown on page 53. The key block may be printed first or last, depending upon the color; light colors should be printed first.

Block prints in color may be made by printing the key block and then coloring by hand with tempera or water colors.

PRINTING THE LINOLEUM BLOCK

The block when fully corrected is ready to print. This is done by coating the surface with ink, covering it with paper, and exerting pressure on the paper. Much care must be taken not to slur the print while removing it from the block.

Two inks are made for printing linoleum blocks. One is the regular printer's ink. It is cleaned off the brayer and block with gasoline, benzine, or kerosene. The other is known as water-soluble linoleum ink. It is removed with water. Either is satisfactory and both are prepared in white, black, and many colors.

The ink is applied to the block with the brayer. This is a composition roller capable of picking up the correct amount of ink from the ink slab, as shown in step 1 on page 56. By rolling the brayer over the block the ink is transferred to the engraving. The linoleum needs a fairly heavy coating of ink, and it is best to roll the brayer from top to bottom and from side to side several times. This gives a more even distribution.

There are several methods of taking a proof shown on page 56. One method is to run the block through a wringer. When using the wringer, loosen both top tension screws so that block and paper can pass between the rollers. The wringer will print only unmounted linoleum. Be sure the paper on top of the inked block is not allowed to slip or shift. To overcome this, some workers prefer to make a holding device. This can be made from two pieces of lightweight cardboard several inches longer and wider than the block. A third piece of cardboard as wide as the linoleum is thick is placed at one end. This is held in place by adhesive tape and connects the top and bottom boards. The whole thing looks like the outside of a writing tablet with the paper removed. Lay the inked block up to the end cardboard, place the paper to be printed on the block, and cover with the upper cardboard. A box built under the wringer assists in printing but is not entirely necessary.

The block of wood and mallet are another means of printing, but not as good as the wringer. Ink the block, place several sheets of paper above it, and lay a fairly thick hardwood block on top of everything. Be sure the wood is centered over the linoleum. Strike one forceful blow in the center of the wood with a wooden mallet or a hammer. With care remove the paper. If the block of wood does not have a perfectly level surface an imperfect print results. Striking the block off center also produces a poor print.

A rolling pin may be used to take prints from linoleum engravings. Place several sheets of paper above the linoleum. Be sure the paper is not moved when rolling with the pin or a slurred print will result.

A table press for printing good copies from linoleum can be made by any handy boy if he follows the directions given here. The cost of this press, which has proved quite successful, should not be more than one dollar.

MAKING A HAND BLOCK PRINTING PRESS

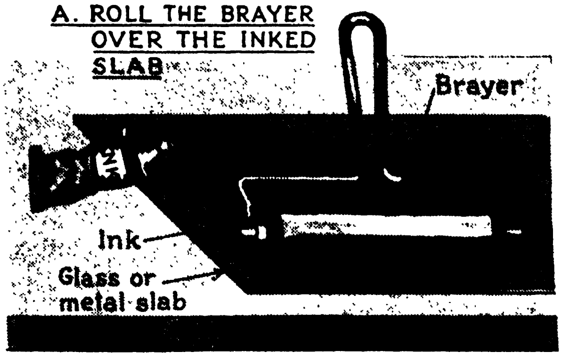
Secure a piece of well-dried and seasoned wood 2″ thick, 8″ wide, and 24″ long for the base. Hardwood is better than pine, but the latter will do. The top and bottom surfaces must be very level and smooth.

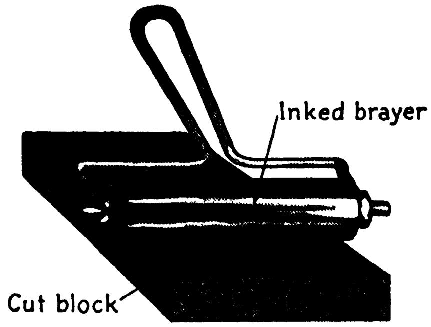
LINOLEUM ENGRAVING

MAKING THE PRINT

1. INK THE BLOCK

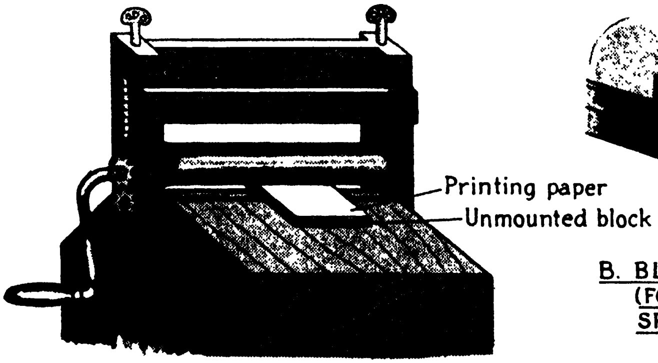
A. ROLL THE BRAYER OVER THE INKED SLAB



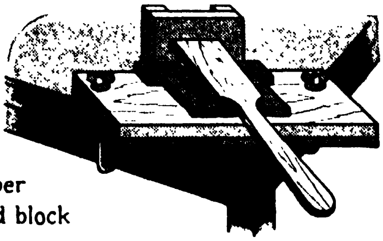


B. ROLL THE INKED BRAYER OVER THE CUT BLOCK

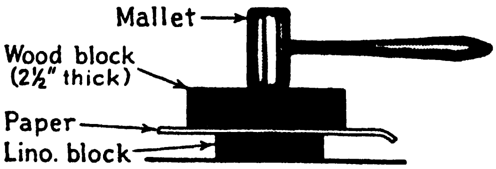
2. PRINT THE BLOCK (FOUR METHODS OF PRINTING SHOWN)



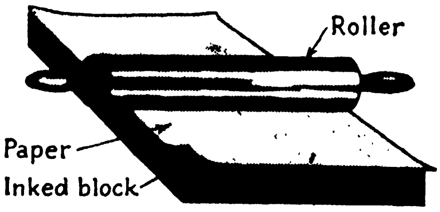
A. WRINGER METHOD : FOR UNMOUNTED BLOCKS (PLACE PRINTING PAPER ON TOP OF INKED BLOCK; HOLD FIRMLY WITH THE HAND; RUN THROUGH WRINGER)



B. BLOCK PRINTING PRESS (FOLLOW DIRECTIONS FOR SPECIFIC PRESS)

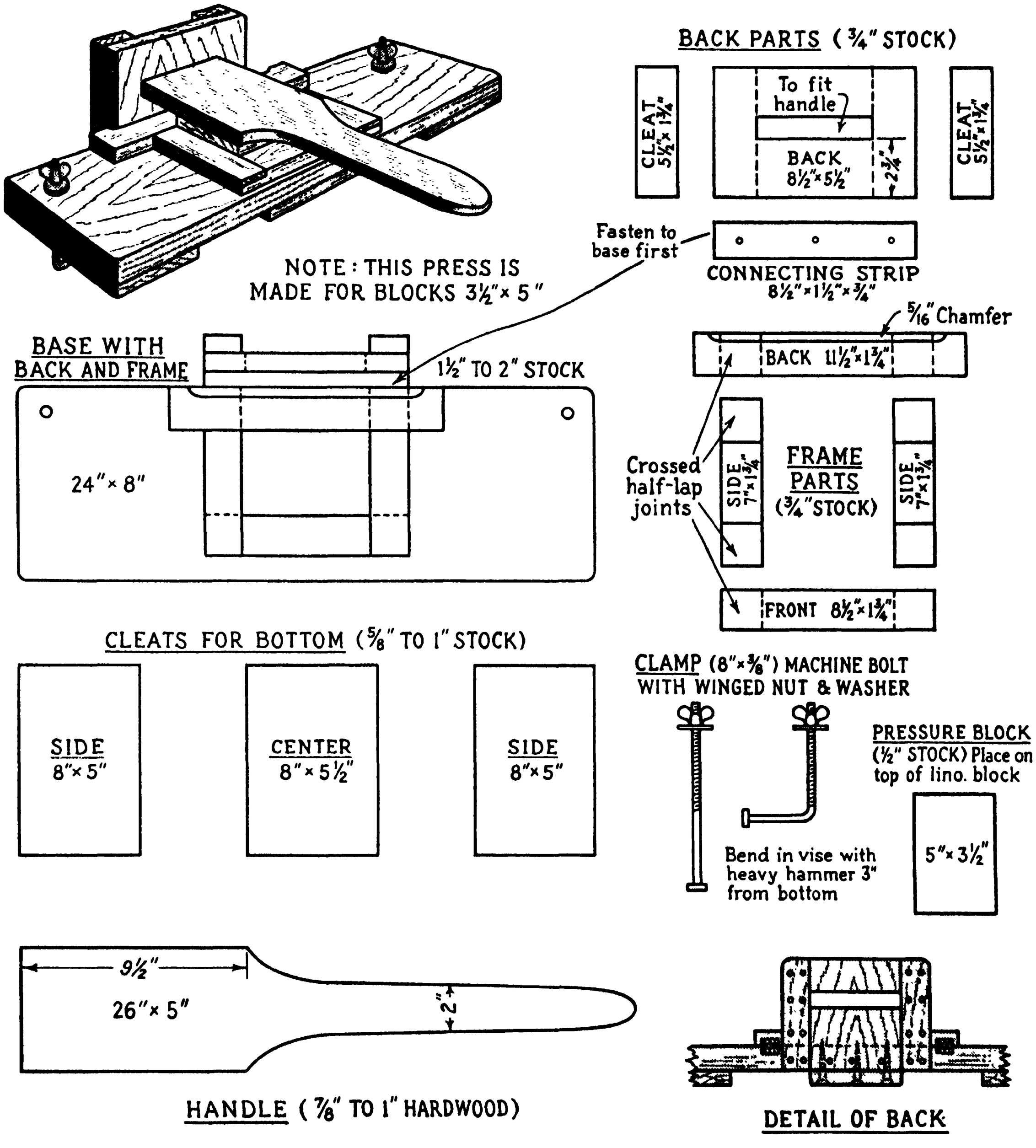


C. MALLET OR HAMMER METHOD



D. ROLLER METHOD (MOVE THE ROLLER BACK AND FORTH OVER THE SURFACE OF THE PAPER)

MAKING A HAND BLOCK PRINTING PRESS



This is important if good prints are expected.

Screw the two outside cleats below the baseboard. They are the 5″ x 8″ pieces of wood shown on page 57. Have the grain of the wood run in the opposite direction from that of the base. This will prevent future warping. Use about eight No. 10 flat-headed wood screws in each piece. The center cleat will be put in place later. Round off the corners of the base if you desire. Bore two $\frac{3}{8}$″ holes, one in each back corner, to receive the fastening bolts. The holes are $1\frac{1}{2}$″ in from each edge.

To make the handle, secure a piece of hardwood and shape it as shown on page 57. Round the handle so that the hands are not hurt while using the press. Sandpaper it well.

Make the back next. The pieces are about $\frac{3}{4}$″ thick and can be of softwood. Cut the slot for the handle about $\frac{1}{16}$″ wider and longer than the handle is wide and thick. The *cleats*, or extra boards, across the back are to keep it from breaking when pressure is placed on the handle. They are fastened by using No. 8 roundheaded screws. Use eight of these $1\frac{1}{2}$″ long.

A piece of wood, called the *connecting strip*, is fastened between the slotted back and the base. This is necessary so that the frame may be lifted before and after each printing. The piece is $\frac{3}{4}$″ thick, as wide as the base is thick, and $8\frac{1}{2}$″ long. Several $1\frac{1}{2}$″ No. 10 flat-headed wood screws are used to fasten it. A small amount of glue between the surfaces will make the joint hold better. To this strip fasten the slotted back by using No. 10 flat-headed wood screws. Place a thin film of glue between the wood surfaces for strength.

The center cleat for the bottom should now be fastened in place. Put it so the end of the cleat is even with the back of the slotted backboard. Five or six flat-headed screws are necessary in the base, and three should extend into the backpiece from the bottom of this cleat.

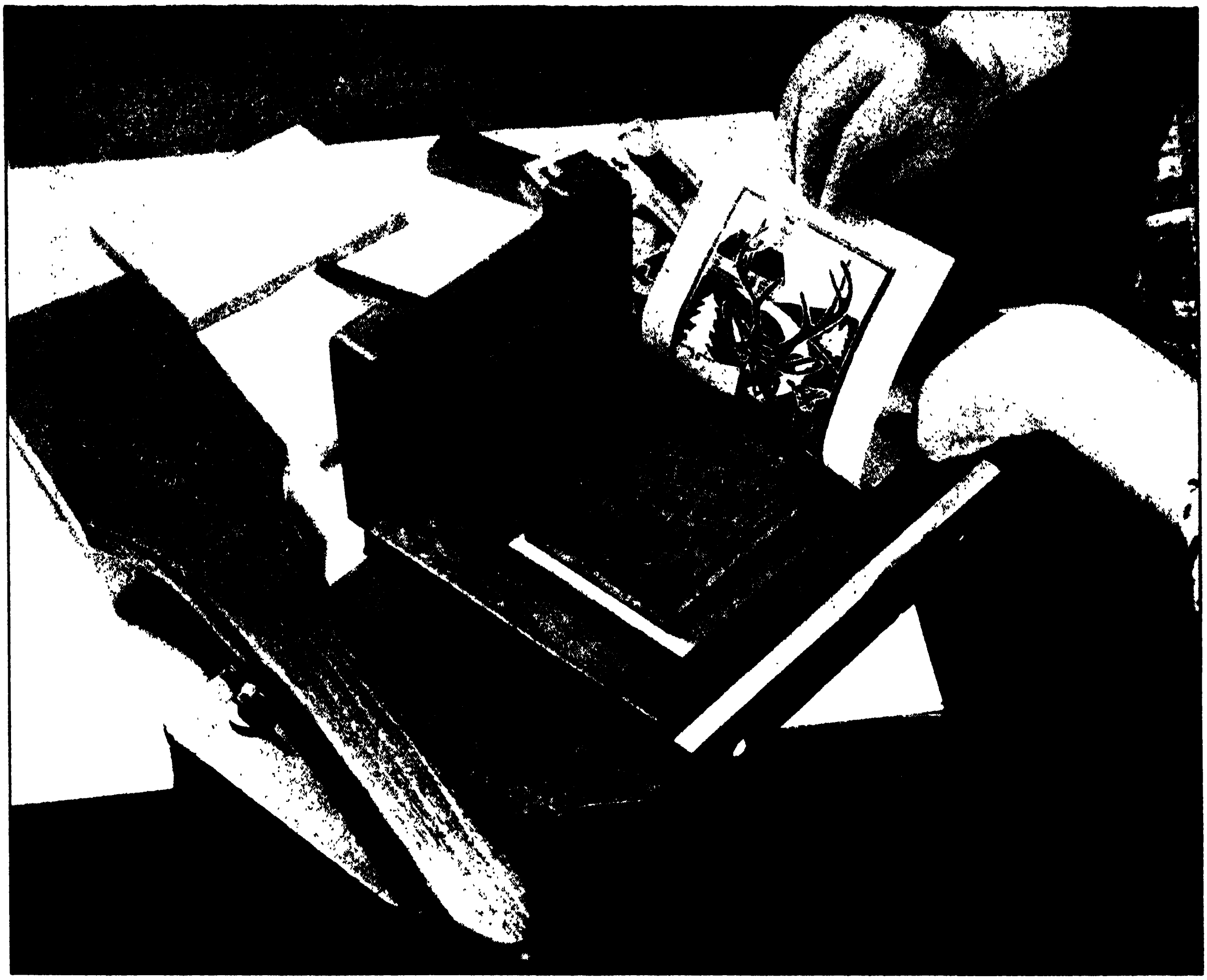
The frame is made of $\frac{3}{4}$″ softwood and the joints are screwed together with three or four $\frac{3}{4}$″ No. 6 flat-headed steel screws. This frame is used to help center the block for printing. It is made by constructing four half-lap joints. The back needs a $\frac{5}{16}$″ chamfer so that the frame can be raised high enough to put in and take out the paper. Two 1″ tight-pin butt hinges of brass fasten the frame to the back of the base. About $\frac{1}{8}$″ space is left between the frame and the base to allow for a rubber or felt pad that is put on later.

Two $\frac{3}{8}$″ x 8″ machine bolts can be purchased and bent at right angles in a vise. These act as the holding device to clamp the press to a table when in use. They may be bent cold. A pad of wood is necessary on top of the linoleum block so that the pressure is exerted evenly over the entire surface. This is the pressure block shown in the drawing. A layer of felt or rubber about $\frac{1}{8}$″ thick should be cemented and tacked to the base of the press below the hinged frame. This gives a better impression when printing.

Using the Press

Clamp the press securely to the corner of a bench. Place the sheet of paper that is to be printed on the felt and above it place the inked linoleum block. Then place the pressure block and with *one* quick, sharp downward pressure of the handle make the impression. Do not chop up and down several times with the handle or a slurred print will result. You might bring the handle down into place and then strike *one* hard blow on the handle directly over the linoleum block with a wooden mallet.

In printing linoleum blocks, do not expect the perfect black and white impres-



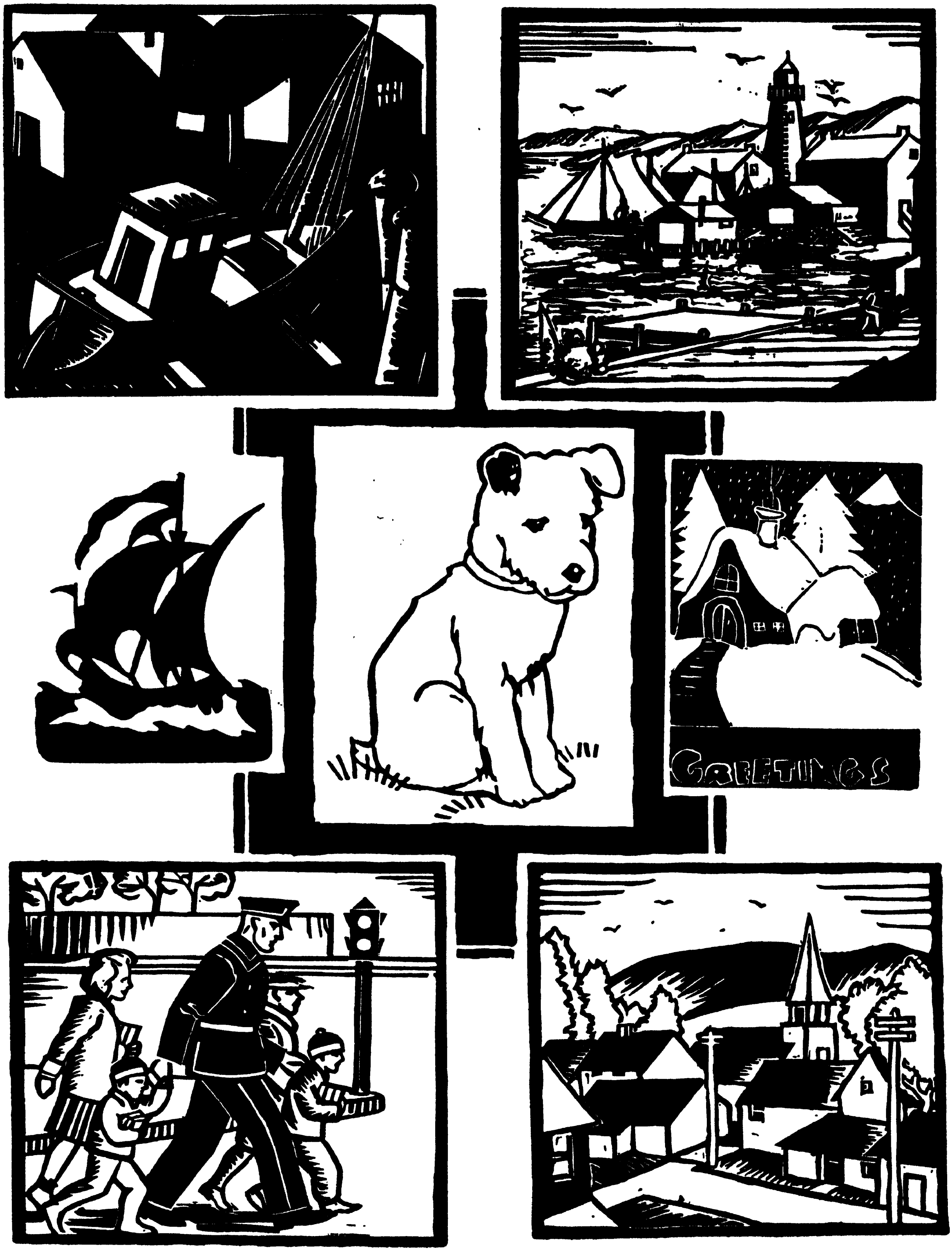
REMOVING A LINOLEUM PRINT FROM A HAND PRESS

sion you would receive from a zinc plate. Shades of soft gray are more desirable and a medium-soft porous paper is often used for printing.

HOW LINOLEUM IS MADE

Linoleum was first made in England in 1862. Frederick Walton was trying to make imitation-leather bookbinding material. Through his work linoleum was discovered. It did not help the bookbinders but opened a new field for floor, wall, shelf, and table covers.

A thick linseed oil, the same as that contained in paint and varnish, is used to make linoleum. A gum called Kauri gum, rosin, ground cork, wood flour, and pigment or color are added to the oil. The pigment may be colored earth or it may be made by combining several chemicals. The ingredients are carefully weighed into proper proportions, mixed on the floor of the factory, and placed in large machines for further mixing. A plastic mass coming from the spout of the machine is passed between huge heated steel rollers and squeezed together into a firm sheet of linoleum. Cloth is cemented to the back and both go through more rollers that press to the correct thickness and give the finished linoleum two coats



LINOLEUM PRINTS BY HIGH SCHOOL STUDENTS

of wax. It is then hung in huge ovens for weeks to season before it is ready to be sold.

Today's product is manufactured from almost the same materials that the inventor used. He called it linoleum from two Latin words—*linum*, which means flax, the plant whose seed gives us linseed oil, and *oleum*, the word meaning oil.

SUMMARY

Linoleum-block prints are an easy and inexpensive means of making illustrations. The design is first drawn on ordinary paper and then transferred to tracing paper. So that the design will appear in the right position when printed, the drawing is reversed when placed on the block. The parts of the design that are to print may be inked so that they will not be accidentally cut off when engraving. Use care in working so that the cuts are not so deep as to weaken the block. The edges of the lines are to be clear and distinct. It is possible to print in colors with linoleum blocks. Several methods of making an imprint are possible: mallet, wringer, roller, proof press, and hand-block press.

QUESTIONS

1. What are some things that might be illustrated with a linoleum block?
2. How can the wax be removed from the surface of linoleum before engraving? Why should this wax be removed?
3. If regular printer's ink is used in printing the linoleum engraving, how should it be cleaned off the block?
4. How deep should linoleum be cut when engraving open spaces?
5. Should cuts be made toward or away from the design of the linoleum engraving?
6. How can prints from a linoleum engraving be made?
7. What are three things that are used in making linoleum?
8. What is the next step after the design has been traced on the linoleum?
9. How does chalk help in linoleum engraving?
10. There are five methods of treating linoleum engravings. What are two of these and how are they done?

TOPICS FOR DISCUSSION

1. How Linoleum Was Discovered.
2. Making My Own Linoleum-Engraving Tool.
3. How to Print Linoleum Blocks.
4. Cleaning Linoleum for Engraving.
5. Linoleum-Block Color Printing.

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CHAPTER VII

WOODCUTS, ENGRAVINGS, ETCHINGS

THE USE OF WOODCUTS

Woodcuts are designs carved into blocks of wood that have been cut exactly as high as type. The block is then inked and prints are made from it. For many years the artist engraved or cut his block of wood by hand. The print was made by placing hand-made paper on the inked block and rubbing on the back of the paper.

Making a Woodcut

Bookmarks, cartoons, and Christmas cards may be made by using woodcuts. Beginners will find that poplar or basswood makes a good surface for both carving and printing. After a little experience you might want to use cherry or walnut for the printing surface these woods give. Each pore of the grain will show as a pattern on the print if an open-grained wood is used. This makes a pleasing effect.

The tools to be used are the same as for engraving linoleum. It saves time to sharpen the cutters often on an oilstone. With sharp tools one can produce better work more quickly.

To make the woodcut, prepare the wood block, type high, with woodworking tools and square it to size. Type is .918 inch high, or approximately $\frac{11}{12}$″. Level the block by sanding *with the grain.* Use fine sandpaper on a block of wood. Cover the surface with one or two coats of shellac and smooth with fine steel wool when dry. Transfer your design in reverse to the prepared surface. See page 47 for instructions on preparing designs in reverse.

Screw two pieces of ½″ wood to a drawing board or other suitable piece of wood to form a bench stop as shown on page 63. Both hands are then free for carving. With a *very sharp* knife outline the design and remove the wood in a "V" around the design. Using large and small gouges remove the excess material from the background. Gouges are chisels with curved blades.

To Print the Woodcut

The best printing of woodcuts can be done on a printing press. If you plan to print with a press, see pages 16 to 18, for locking the cut in a chase and making ready on the press. Other methods used are a rolling pin, a mallet, or a linoleum printing press.

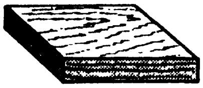
Place a small bit of printer's ink on a 9″ x 12″ glass or a sheet of tin and spread it evenly over the surface with the printer's roller. Transfer the ink to the woodcut with the brayer. Ink from side to side and top to bottom.

If you print copies by using a rolling pin, place the inked block on a table with the ink surface up. Place several sheets of paper on the ink and roll the pin over

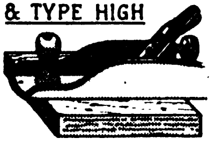
WOODCUTS

PREPARING THE BLOCK

1. CUT WOOD TO EXACT SIZE

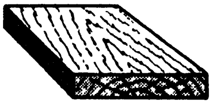


2. PLANE SURFACES PARALLEL TO GRAIN & TYPE HIGH



MATERIALS AND TOOLS

BLOCK OF WOOD (1" THICK)

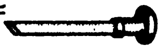


PRINTING PAPER

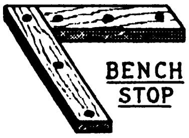
PRINTING INK

CUTTING KNIFE

CHISEL



GOUGE

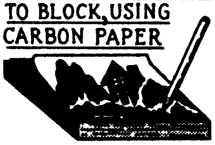


BENCH STOP

PREPARING THE DESIGN

1. PLAN DESIGN WITH BRUSH AND INK

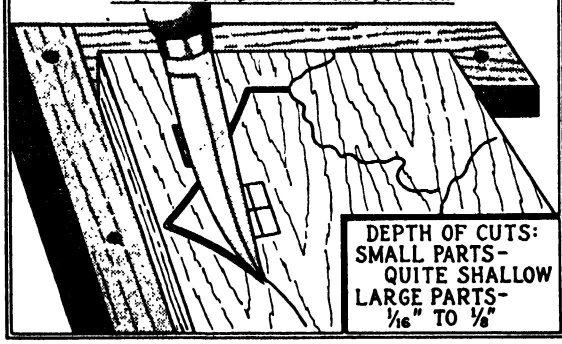
2. TRANSFER DESIGN TO BLOCK, USING CARBON PAPER



CUTTING THE BLOCK

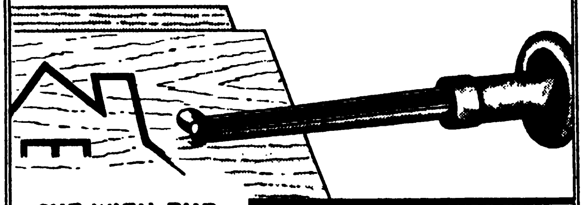
1. CUT LEFT SIDE, THEN RIGHT SIDE, OF OUTLINES TO MAKE "V" TRENCH

HOLD KNIFE NEARLY VERTICAL, INCLINE BLADE SLIGHTLY OUTWARD



DEPTH OF CUTS:
SMALL PARTS-QUITE SHALLOW
LARGE PARTS-$\frac{1}{16}$" TO $\frac{1}{8}$"

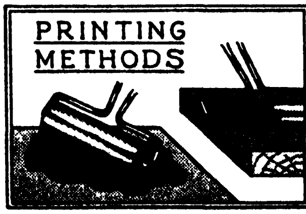
2. CLEAR AWAY BACKGROUND AREAS WITH GOUGES AND CHISEL

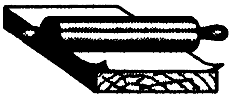


CUT WITH THE GRAIN OF WOOD

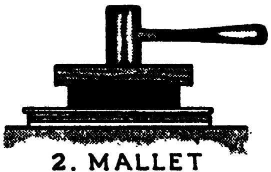
USE LARGE GOUGE OR CHISEL TO CLEAR LARGE AREAS; USE SMALL GOUGE TO TRUE UP PLANES AND TO ADD DETAILS

PRINTING METHODS

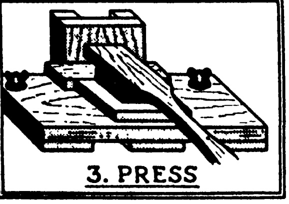




1. ROLLER



2. MALLET



3. PRESS

them. Now remove the paper without dragging *it over the wet surface.*

Prints are made with a mallet by first placing two or three sheets of paper on a table. Then ink the block and place it face down on the paper. Place a second block on top of the woodcut to protect it. Strike a sharp blow directly in the center of the second block with a wooden mallet. Now carefully remove both blocks.

If you wish to use a linoleum printing press, read how to make and use one on pages 55 to 59.

Machine methods have greatly changed the making of woodcuts. A few woodcuts are still used but are now made differently. The design is traced or printed from a photograph negative in reverse on the wood, and most of the engraving is done by a machine called a *router.* A small amount of fine handwork is necessary to finish the cutting. Close-grained woods are used, such as box or pear.

Woodcuts are not usually placed in the press for printing because they would wear away too fast. They are locked with the type and immersed in a chemical bath where a thin shell of copper is deposited over their surface with the aid of the chemicals and electricity. This copper shell is removed, filled with lead on the hollow back, and used for the printing. Machinery and jewelry are often pictured by means of woodcuts. Wood prints may be known by the clearness and sharpness in the detail of the illustration. They do not give the natural likeness of a photograph but have the stiff appearance of solid or broken lines.

Very large type is sometimes cut from blocks of wood, type high, and used for newspaper headlines and for large letters that are necessary elsewhere. The advantage is that these letters do not weigh so much as if made of metal.

ENGRAVING AND ETCHING

Engravings and etchings are used on the printing press to reproduce pictures and designs. Engraving plates are made by cutting or scratching lines into smooth level surfaces. Printer's ink is then forced into these openings. When paper is pressed against the plate it picks up the ink from the ink-filled lines. An etching is made by first photographing the picture or object to be reproduced. Then, by mechanical and chemical processes a duplicate image is made on a piece of metal called a *plate.* Printer's ink is applied to the plate and a copy made from the plate.

These methods of illustration are of great help to the printing industry. They enable man to show by example what he is trying to have people understand. It has been said that one good picture is better than several thousand words. Books and papers that have descriptive pictures in them are much more interesting than those without.

Color Printing

To reproduce pictures on a printing press, a metal plate of the original drawing is necessary. Only one plate is necessary when the print is to be in one color. Printing in colors has been greatly developed during the last twenty years by our scientists. To print in color a duplicate of an oil painting, three plates at least are necessary, one to print the yellow, another for the red, and a third for blue. You will remember from your art work that these are the primary colors and any color except white and black can be made from their combinations. By overlapping these colors in different proportions any color can be made. Yellow is printed first, then the red is put over it, and blue is placed on third. Where black is used, a fourth plate is made and printed last. White is secured from the paper itself.

Scientists have been able to produce a camera that is capable of taking three pictures of the object at the same time. One picture records all the yellow, the second records all the red, and the third all of the blue. These films are developed with acid and then are used to make printing plates.

Hand Engraving

Until man learned how to use a camera to help in making plates for printing, he had to engrave them by hand. About the middle of the fifteenth century artists began to scratch lines on metal plates and use these plates for printing. Although the plates wore better than woodcuts and finer lines could be produced, it took the engraver much longer to make his metal engraving.

Etchings first appeared about the end of the seventeenth century. In this process the lines of the drawing were formed by means of the chemical action of acid eating on the metal. At about this same time a form of engraving known as *mezzotint* came into use. This engraving was done on a roughened copper plate which was polished to make the lines of the drawing from which the print was made. Mezzotint was much speedier than the other methods in use but required greater skill.

Making Gravers for Engraving

Graving tools may be made from any very hard steel such as old files, scribers, power hacksaw blades, or from tool steel. The tools shown on page 66 were made from parts of a broken fencing foil.

Secure the steel and soften it by heating to a dull-red color. This is called *annealing*. Allow the steel to cool slowly. Work the metal to shape with a file as shown in the drawings. Form a wooden handle on a lathe or by hand. Place a brass collar or ferrule on the handle so that it will not split when the tool is inserted. Heat the shaped cutter red hot and quickly plunge it into water to harden it again. After cooling, insert the cutter into the handle by drilling a hole in the wood a little smaller than the shank. Finally, sharpen the tool on an oilstone.

ENGRAVING A PRINTING PLATE

Copper is an interesting material on which you can make a printing plate, or *cut*. Zinc is somewhat softer and will serve the same purpose. Commercially line drawings are reproduced on zinc and photographs on copper.

Secure a rectangle of copper or zinc large enough for the picture. It should be 20 gauge in thickness and have a smooth surface free of all bends, kinks, or scratches. Before engraving try the tools on some scrap metal.

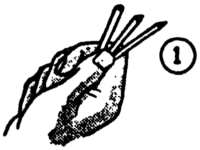
Mount the copper on a level piece of dry wood that has been squared to size. Place copper tacks near each corner of the block. Be sure the heads are slightly below the surface of the wood. Cover the heads of all tacks with a small lump of solder. Place the piece of copper to be engraved on the block of wood and solder it securely to the tacks.

Transfer the design to the copper with carbon paper or draw the picture directly on the copper with a lead pencil. Be sure it is in reverse. Cut the design with an engraving tool by pushing the tool away from you like a linoleum cutter. Polish the surface with fine steel wool.

To print with this plate, lock the cut in a chase. If it is not type high, *underlay* or shim it to height by gluing cardboard below the base. Scrape some halftone printer's ink across the surface with a straight piece of copper or brass. The ink will be forced into the cuts of the design. Now, wipe off all ink from the surface of the plate. Place pieces of newsprint paper around a smooth level piece of wood for the wiper. Dampen

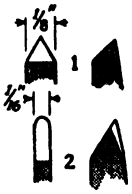
ENGRAVING AND ETCHING

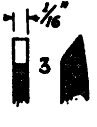
MAKING GRAVERS



① USE SMALL PIECES OF TOOL STEEL SUCH AS FILES OR DRILL ROD

② TO SOFTEN (ANNEAL) TOOL STEEL, HEAT IT RED HOT AND LET IT COOL SLOWLY IN SAND





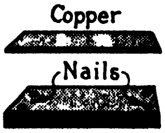
③ MAKE 3 STYLES OF POINTS. FILE OR GRIND TO SHAPE

④ TO HARDEN, HEAT RED HOT & COOL IN WATER

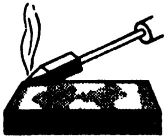
⑤ SHARPEN

MAKING AN ENGRAVED PLATE

① USE 20 GAUGE COPPER, WOOD BLOCK, AND LARGE TACKS



② DRIVE TACKS SLIGHTLY BELOW SURFACE OF WOOD. TIN THEM HEAVILY WITH SOLDER

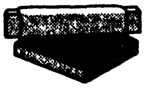


③ APPLY HEAT WITH SOLDERING COPPER UNTIL SOLDER BENEATH MELTS AND FLOWS

④ TRANSFER DESIGN TO COPPER

⑤ USE NO. 2 GRAVER. PROCEED CAREFULLY. AVOID SLIPPING

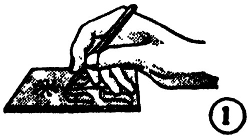
⑥ MAKE AN INK WIPER OF WOOD WOUND WITH PAPER



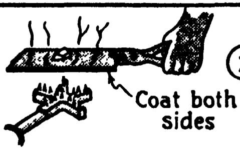
⑦ SCRAPE IN HALFTONE INK – WIPE OFF, LEAVING INK IN LINES

⑧ PRESS HEAVILY IN CLAMP OF LEVER PAPER CUTTER

MAKING AN ETCHED PLATE

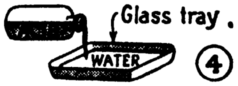


① DRAW DESIGN ON COPPER

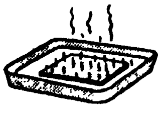


② MELT BEESWAX OR PARAFFIN ON COPPER

③ SCRATCH THROUGH WAX WITH SCRIBER

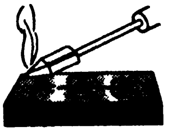


④ MIX NITRIC ACID SOLUTION. ALWAYS POUR ACID INTO WATER

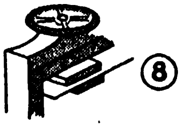


⑤ ETCH PLATE

⑥ WASH



⑦ MOUNT AND INK



⑧ PRESS

with water the back of the paper that is to receive the impression and place it over the cut. Over this paper put one or two layers of blotting paper or a sheet of soft rubber. Give a hard impression to the cut by printing under the clamp of a lever paper cutter. If a white line object on a black background is desired, lock the plate in the press and print the same as a linoleum block or woodcut. Clean the whole plate after a few impressions so that the ink will not clog the fine lines.

ETCHING A COPPER PLATE

Place a design on a rectangle of sheet copper using carbon paper, or you may draw directly on the copper with a pencil. Cover the metal and design with a thin film of beeswax by heating the metal slightly and applying the wax. With a knife blade and a fine-pointed instrument scrape off the wax to make the design.

You etch the metal with nitric acid. Make a weak solution of nitric acid by *adding the acid to the water.* Use about one fourth as much acid as water and always use acid in a *glass or granite tray.* Place the wax-covered plate in a dish and pour on the weak acid until the plate is covered.

When the design is deep enough, remove the metal and rinse with water. Take off the wax by heating and wiping with a cloth. Polish the surface with fine steel wool. Mount and print your etching the same as you did the engraving.

SUMMARY

Woodcuts are a popular means of producing artistic illustrations. The grain of the wood often gives a most pleasing effect. The hand-carved woodcut is made in the same manner as a linoleum block. Commercial woodcuts are usually engraved by a machine with some fine handwork to finish the cutting. Woodcuts give a clear, sharp print that is excellent for details in an illustration but has a somewhat stiff appearance. Two other common methods of illustration are the engraving and etching as produced on metal plates. Commercially, line drawings are produced on zinc and photographs on copper. In the engraving the same process of cutting with tools is used, while in etchings the lines are formed by the action of acid on the exposed portions of the plate in an etching bath.

QUESTIONS

1. If you had a rough block of wood how would you prepare it so that it could be used for a printing surface?
2. What kinds of wood are good for beginners to use in making printing plates?
3. How high should the block be made so it will print in a press?
4. What is a gouge and for what is it used?
5. What things are often shown today by the use of woodcuts?
6. Do printers print directly from these woodcuts?
7. How are engraving plates made?
8. How is a colored picture printed?
9. What is meant by etching?
10. What metal is good to use for etchings?

TOPICS FOR DISCUSSION

1. Etching a Printing Plate.
2. Making a Graver.
3. How Woodcuts Are Made.
4. Printing a Picture in Color.
5. My Experiences Using a Graver.

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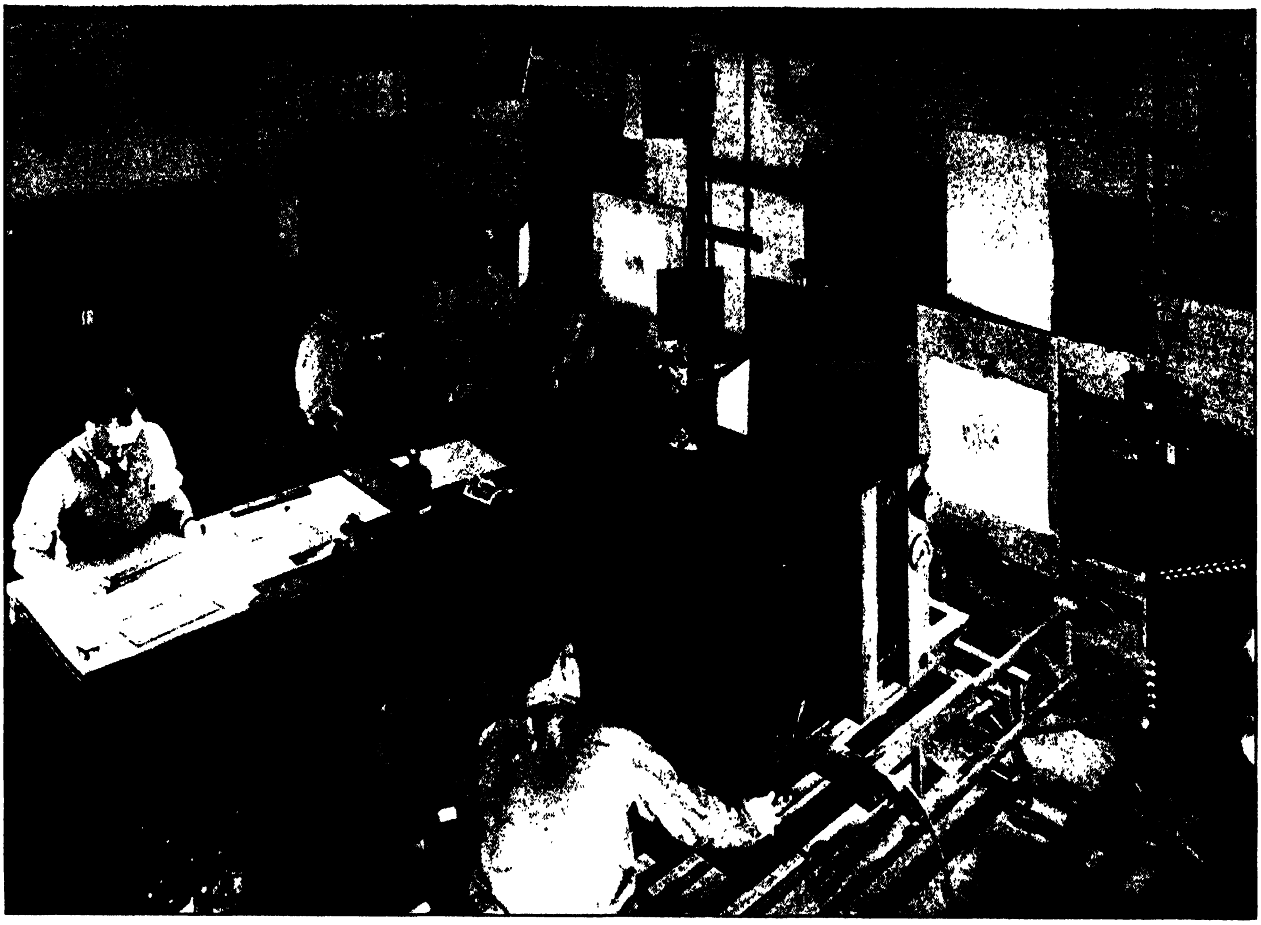


PREPARING PHOTOENGRAVINGS—MAKING EXPOSURES

CHAPTER VIII

PHOTOENGRAVING, ROTOGRAVURE, LITHOGRAPHY

PHOTOENGRAVING

The preparation of printing plates by the use of a special camera, metal plates, crosslined glass, and chemicals is known as photoengraving.

Halftone Plates

The halftone process is a method of reproduction for making a printing plate with the help of a camera. Its name comes from the fact that the finished print shows many different shades in gray as well as black and white. This is the most commonly used process for printing pictures in books, magazines, and newspapers. It was first used commercially about 1880.

The halftone process begins by photographing an object or picture through a crosslined screen which breaks the solid tones into a multitude of fine dots. This screen is made of two pieces of glass on which lines are engraved and filled with a black pigment. These two pieces of glass are cemented together with the lines running at right angles. The screens used for halftones are known by the number of lines to the inch. Those most commonly used are 60, 85, 100, 120, 133, and 150 line. The finer the screen, the less noticeable the dots and the more detail appears in the printed picture. Newspapers use a 60- to 80-line screen while a 120- to 133-line screen is generally used for book illustrations.

The copy is placed before a camera which has the proper screen just in front of the ground glass. The camera is focused to obtain the proper size and sharp detail on the ground glass. This glass is removed and sensitized glass on which the copy is to be photographed is put in its place. The light is turned on the copy and the exposure made. The sensitized glass is developed as is any photographic negative. When developed, the dots of various sizes appear.

The forming of these dots by the lines of the cross-screen, which allow the reflected light from the copy to strike the negative only through the openings, is the basis of the halftone. Each small opening makes an individual tiny picture of that part of the copy which strikes it. The strong rays which come from the high lights of the copy make larger dots on the negative since more light passes through the screen at that point causing a stronger exposure. As the light varies from the high lights to the dark spots, it becomes less intense and causes a weaker exposure of these parts and forms dots which grow smaller in size. These differences in size cause the different tones of the picture and make it possible to produce an exact copy of the picture or object.

After being developed, the emulsion or treated side of the negative is placed in reverse on a copper plate which has been coated with a sensitized preparation. A powerful light is turned on the negative and the plate to harden the sensitized coating. The spots where the light does not strike remain soft and the emulsion will wash off in water.

The print produced on the copper plate represents the picture as it is to finally appear except that it is in a reversed position. After being developed, the plate is baked over a gas flame to harden the image. The plate is placed in the etching bath, where the acid eats away the metal surface not covered by the image. The parts covered by the print are left in relief to form the printing surface. Any imperfections in the etched surface are then removed by hand.

Colored Halftone Plates

Separate plates are used to produce the desired colors when printing color work. In the making of a color halftone plate, a color filter is placed before the lens while the negative is being made. These filters are either a colored gelatin film between glass or a colored liquid in a transparent container. The filter absorbs all colors except one, which is photographed in full strength. A separate plate is made for the yellow, for the red, and for the blue in color printing. With the use of color, pictures printed on a press are an almost true reproduction of the original.

For color printing most firms use four plates. One plate first prints all the yellow. The second plate prints red and some of this red overlaps the yellow to form various shades of orange. Blue is printed next from the blue plate. Where the blue overlaps, orange brown is produced. Purple is produced by the blue and red ink combination, and green results from the blue and yellow. Lastly, a plate prints black over the picture to give it sharpness or clearness. Some printers omit this last step but the reproduction does not look as good as when black is used.

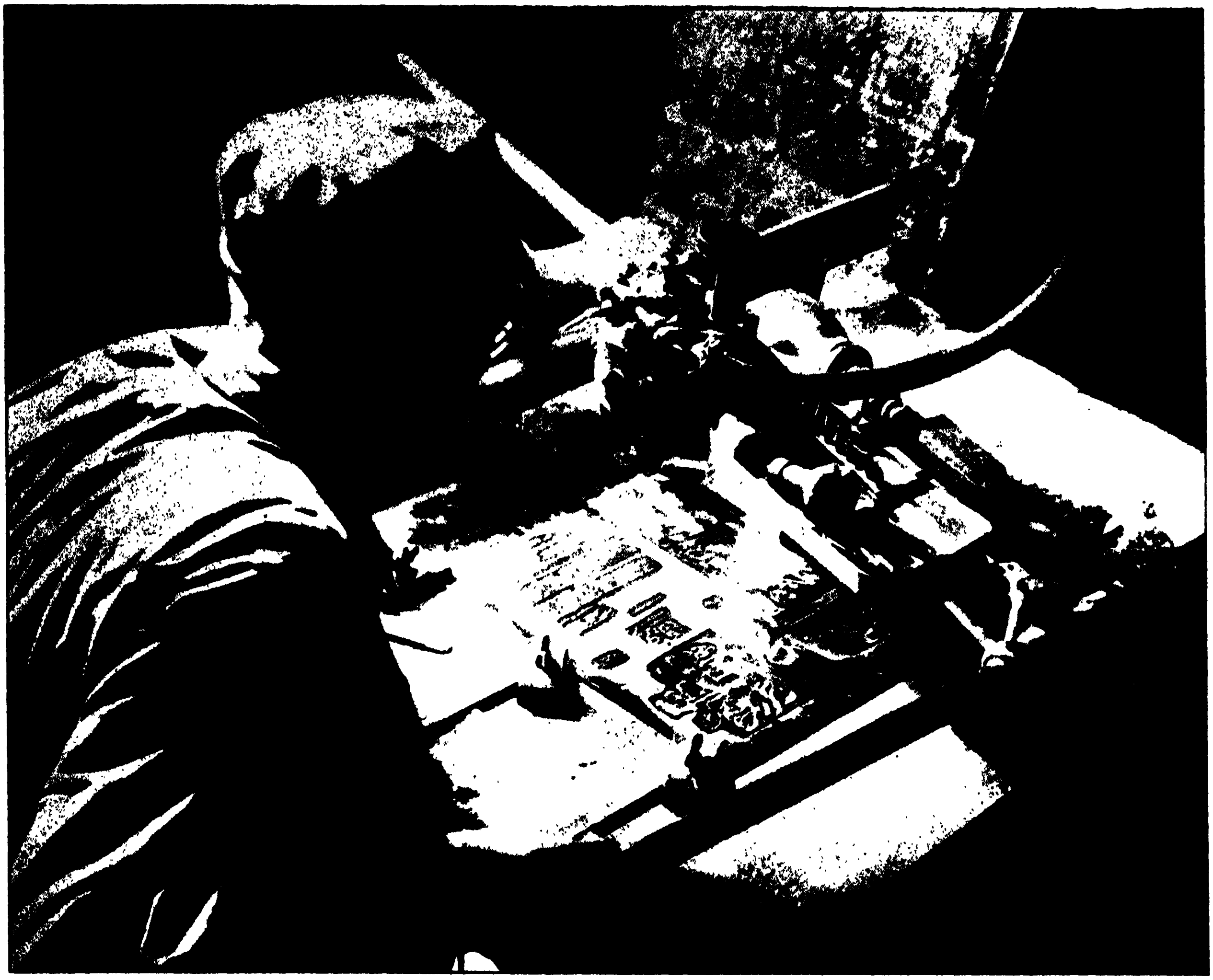
PREPARING PHOTOENGRAVINGS—ETCHING THE PLATE

Line Etching

Line etching is a simple and nonexpensive mechanical process which uses a camera to make plates for printing. These plates are usually made on zinc. Therefore, they are commonly called *zinc etchings* or *line cuts*. They print to resemble pen and ink drawings or linoleum cuts.

The first step in making a line etching is the negative. This is an exposure of the drawing, called the *copy*, on a coated-glass plate which is in a camera. Engravers refer to all material to be reproduced as copy. After the exposure the plate is removed from the camera and is developed and fixed by a chemical process. When the plate has dried, the film side is thinly coated with a solution of rubber cement to protect it from a second coating, called *stripping collodion*, that is then applied. The coatings when dry become a part of the negative. The plate is put into an acid bath in which it remains until the film comes off the glass. The film is then reversed, laid on a thick plate glass, and allowed to dry.

The polished side of a piece of zinc about $\frac{1}{16}''$ thick is now made sensitive to light. The sensitized zinc is placed on top of the negative and put in a frame to be printed. The plate is then inked and the ink sticks



PREPARING PHOTOENGRAVINGS—ROUTING WITH A MACHINE

where the lines have been hardened by the printing process. The emulsion not covered by the ink is now washed away to expose the bare metal. The edges and surfaces on the zinc plate which are not to be etched are painted with an acid-resisting substance. The plate is then etched in a nitric acid bath. The acid acts on the exposed metal and eats it away. This continues until the desired depth is reached.

After it has been etched to the desired depth, the plate is mounted on a temporary block which is type high and the surplus metal in the nonprinting parts is cut out. The *routing*, or cutting, is done by a machine which resembles a drill and is run by an electric motor which has a speed of from 15,000 to 20,000 revolutions a minute. When the routing is completed, the plate is removed from the block and mounted permanently for the press. The plate is then inspected by the finisher who clears and touches up lines with gravers by hand in preparation for delivery.

Line Color Plates

Although line etchings usually print in one color, they may be used to print illustrations of two or more colors. To make the printing plates for this process, a negative is made from the drawing in the same way as for a line etching. As many plates are made of metal as there are to be colors. Each color plate will be printed separately.

ROTOGRAVURE PHOTOENGRAVING

Rotogravure is a process of printing from recesses below the surface which form the design. This is technically known as *intaglio.* The artist draws the picture to be reproduced and three photographs are taken of it if it is to be reproduced in natural colors. One will be the yellow, one the red, and the third the blue. Only one plate is made if only one color is used. In the camera some plates of glass are placed upon which crosslines were scratched which form tiny squares on the film. An artist retouches the film to bring out the important features and then by a special process the picture is transferred to a large steel cylinder about two feet in diameter which has been copperplated on the surface. The copperplated cylinder is etched with acid to form the printing surface. The acid eats the squares into tiny sunken dots and makes cups for the ink. There are sometimes as many as 160,000 cups in a square inch.

This cylinder is placed in a huge rotary press for printing. Ink is pressed into the recesses and scraped off the surface by a steel blade called the *doctor* knife. The smooth surface has been treated with water to keep the ink from adhering where it is not wanted. The cylinder prints on another large roller that is covered with a rubber sheet which transfers the ink to the continuous ribbon of paper passing through the press. The ink comes from the millions of little depressions or cups that form the picture on the copper cylinder.

The deeper the cups, the darker will be the printed part. It is the variation in the depths of these cups that causes the different tones for the high lights and shadows on the printed sheet. Where the print is dark, the cups are deep and hold more ink. In the light parts the cups are shallow and hold less ink.

This method of making illustrations permits rapid printing as the cylinder can be used on rotary presses such as are used for printing newspapers. It is used to make reproductions of paintings, pictures, illustrations for newspaper supplements, inserts for magazines, advertising posters, post cards, color work, pictorial editions, and catalogs.

INDUSTRIAL WORKERS

For making a photoengraving one needs the coöperation of an *artist* to make the drawing. A *photographer* takes the pictures to be produced on the metal plate. The *stripper* is the worker who removes the film and places it on glass so it can be printed on the sensitized metal plate. The *printer* prints the copy on the metal plate. The *etcher* places the developed plate in acid to eat away the unprotected metal to form the image. The parts that should not print are cut away so that a clear plate will be had by the *router.* The *finisher* touches up imperfections by hand with engraving tools and a magnifying glass.

Machines used for the work are cameras, acid tubs, electric-driven routers or carving machines, and a proof press.

The people employed in this work must be skillful, artistic, and of good health. The etchers and routers need especially to be healthy and get much outside exercise because of the acid fumes and dust from the metal and wood with which they work. Boys learn this work either in a trade school, school for printers, or as helpers in a shop. They enter the trade at a salary of about $15 a week and serve for six years as apprentices. Each year their pay is raised

Courtesy Harris Seybold Potter

PRINTING WITH THE OFFSET PRESS

until they become journeymen with a salary of about $62 a week.

Engravers' work is inside, fairly regular with good pay, not too overcrowded, and has few mechanical hazards. There are, however, strain on the eyes and nerves, the danger of contracting disease, and the disadvantage that this trade is not found in every town.

If it is the photography of the printing industry in which you are interested, you want to know both the good and poor parts of that profession. The photographer must be content to live in the larger cities where there will be more chances for employment. The photographer's health in the photoengraving room becomes endangered by the work he has to do because of the acid fumes present. Good photographers do not have difficulty in finding work and are well paid if they are resourceful and clever.

Engraving houses employ artists; and, if you are interested in art work and drawing, you should know that to secure employment you ought to live in some large city where much work is being reproduced for printing. The artists' hours during the rush or busy season are very long. Some offices producing art work are open from nine to fifteen hours a day for several months at a time. The artist is not exposed to dust, gases, or dangerous machines. He does spend much time inside, however. The pay is good, but one must be an excellent artist to hold a good position.

LITHOGRAPHY

Originally the artist drew the design or picture to be reproduced by lithography directly on a smooth level surface of stone with a special wax crayon. He then covered the surface with nitric acid and gum arabic. The stone was then covered with water which was absorbed into the stone except where the greaselike crayon had marked. The stone was then inked with a greasy ink for printing. The ink adhered to the crayon design and did not adhere to the wet surface of the stone. A print was then made. Separate stones were necessary for each color that was to appear on the finished work.

This type of printing is now done with metal plates made by using cameras and chemicals. The metal, usually a copper plate on a steel cylinder, is treated with chemicals so that when it is placed in the press ink adheres only to the part that is to print.

Lithographed work may be identified by the clean, sharp lines in soft, even colors. There is no trace of the design on the reverse side of the printed sheet as is often found in letterpress printing. Lithography is used to print letterheads, checks, stock and bond certificates, insurance policies, diplomas, and other forms which have fine lines. The better class of labels in one or more colors, posters for billboards, and window-display work are also produced by this process.

Those workers employed to make lithograph plates must be intelligent, skillful, artistic, and have good eyesight. Color mixers and artists possess a keen sense of color combinations. The young men in the plate-making rooms begin work at about $15 a week. Photographers earn about $75 a week. Pressmen are usually paid from $45 to $75 a week.

SUMMARY

The most commonly used means for printing pictures is the halftone process in which the plate is made by means of a camera. Crosslines on a special glass screen break up the picture being photographed into many dots. The difference in size of these dots produces the different shades in the printed illustration. The use of separate plates permits the reproduction of pictures in color. Cartoons and drawings are usually shown by means of line cuts which resemble pen-and-ink drawings. A third method of reproduction is the rotogravure process of intaglio printing, using inked recesses below the surface of the cylinder. It is most commonly used on rotary presses to produce newspaper supplements.

QUESTIONS

1. What is photoengraving?
2. Why does a photographer use a screen between the camera plate and the object he is photographing?
3. After the camera print has been transferred to the copper plate is the object on the copper as it appears on the printed sheets?
4. What is done when a person desires to print an object in natural colors?
5. What type of work do line etchings resemble when printed?
6. After the negative has been transferred to the metal plate for a line etching, how is the surplus metal removed to complete the plate?
7. How does rotogravure differ in principle from line etchings?
8. What do the finishers do in the engraving room?
9. How does lithography differ from halftone work?

10. What are some of the types of printing produced by lithography?

TOPICS FOR DISCUSSION

1. The Origin of Lithography.
2. Photography in an Engraving Room.
3. Our Trip through an Engraving Room.
4. The Workers in the Engraving Room.
5. Halftones in Color.

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CHAPTER IX

SILK-SCREEN PRINTING

Silk-screen printing is done, as the name suggests, by using a piece of silk cloth that has been tightly stretched over a frame easily made in the shop. Instead of printing from type or a plate, the work is printed from a stencil. The design to be reproduced is cut on an especially prepared stencil which is cemented to the underside of the silk screen. A special paint is placed at one end of the frame, a sheet of the material to be printed is placed below, and the paint is then scraped across the piece of silk. Where there are openings in the design, the paint is forced through the silk onto the material below and a print is made. The number of copies desired are printed. Then, if more than one color is needed, a new stencil is cut, placed on the silk, and the next color applied.

Industry is using silk-screen printing more each year. The Chinese used this process many years ago to print designs on cloth. But it is only in the last fifteen years that people in our country have made much use of it. This printing can be done on either flat or curved surfaces. Some of the materials and objects on which this process is used are cloth, metal, fur, wood, oilcloth, glass, grass rugs, furniture, machinery, carpenter aprons, book and catalog covers, milk bottles, water glasses, posters, and store signs. You can print on just about any kind of material or on a surface of any shape with this method. The greatest demand for screen work is in advertising.

The advantages of silk-screen work are that when less than 1000 copies are to be made they can be produced more quickly and cheaply than by using the printing press. Clearer and brighter colors can be secured because special paints are used. Only a few hundred dollars are necessary to start in this business while it would take several thousand to equip a print shop.

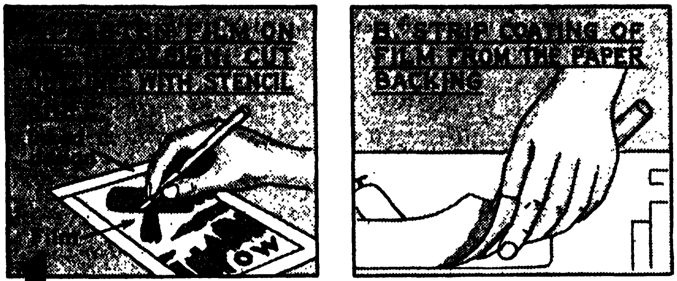
DESIGNING AND PRINTING A POSTER

Many things can be decorated in the shop by using the silk screen, and posters for the school are easily made. You and your friends might want to make some Christmas cards.

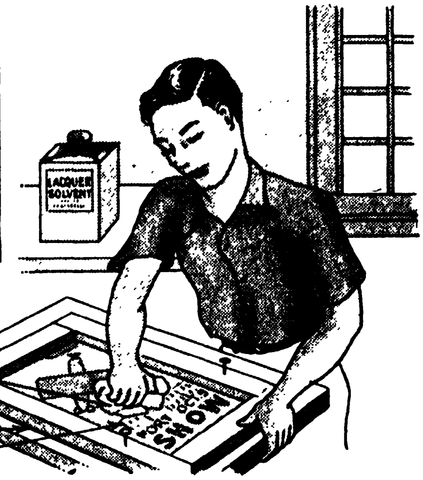
Making the Frame

The frame should be 2″ to 3″ wider and longer than the largest piece you wish to print. Either a butt, half-lap, or miter joint can be used to make this frame. It may be reinforced with L-shaped mending plates on the top surface if desired. Frames up to 12″ x 14″ can be constructed of wood ¾″ thick and 1″ to 2″ wide. Pine, poplar, gum, or other softwood may be used. If a larger frame is to be made, it will be necessary to have 2″ x 2″ stock.

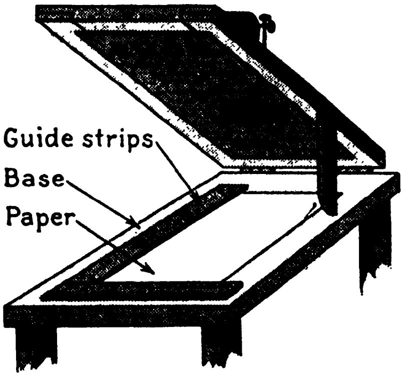
SILK-SCREEN PRINTING PROCESS

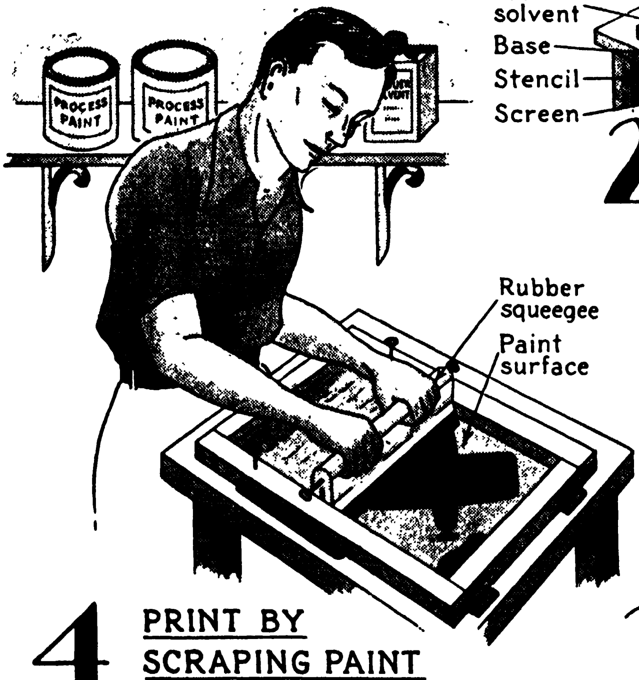

[illegible] FILM ON
[illegible] CUT
[illegible] WITH STENCIL
OW
B. STRIP COATING OF FILM FROM THE PAPER BACKING

1. PREPARE THE FILM STENCIL



2. TRANSFER THE STENCIL TO THE SCREEN





4. PRINT BY SCRAPING PAINT ACROSS THE SCREEN WITH A SQUEEGEE

3. ATTACH THIN PAPER GUIDE STRIPS ON BASE FOR REGISTER; INSERT PRINTING PAPER

Securing a Base

The base is of wood and should be kiln-dried. It must be very level. A piece of ¾″ five-ply wood will make an excellent base because there will be no cracks on the top side. It is advisable to have this base 4″ to 6″ larger than the frame. A small, level table top might be used.

Assembling the Printing Frame

Tightly tack a piece of silk bolting cloth to the bottom side of the wooden frame. A good quality for this is 12XX which can be purchased at art supply stores or, perhaps, from an advertising sign painter. It is 40″ wide and costs about $3.15 a yard. This silk must be free of filler. Organdy, purchased at department stores, can be substituted for silk. Wet the cloth after it has been tacked in place to help tighten it by shrinkage.

Secure two 3″ loose-pin hinges and screw them to the back of the frame. Attach the frame to the base with the silk side down so that the front can be raised. To keep the frame in a raised position, some operators screw a short brace or leg on one side as shown in the drawing on page 77.

Making a Squeegee

Purchase a strip of rubber for the squeegee from an artists' supply store. This rubber is especially made for the work. Fasten the rubber in a piece of wood as shown in the drawing. A straight, stiff piece of cardboard may be used as a squeegee for short runs.

Cutting the Stencil

To make the stencil, purchase the material known to the tradesman as Profilm. It can be secured from an artists' supply house. Fasten the design for the poster you have chosen to a drawing board and then cover it with a sheet of Profilm.

With a stencil knife cut through the orange coating on the film, which is a compound on waxed paper. *Do not* cut too deep. Strip off the orange coating with the aid of the stencil knife where you wish color to print later. See drawing 1.

Attaching the Stencil

Place the stencil, compound side up, on a level surface. Over the film put the frame with the cloth side down.

To fasten the stencil, wet a soft pad of cloth with lacquer thinner and squeeze out all surplus liquid. Briskly rub the thinner over one corner of the stencil three or four times. In a second or two rub dry with a pad of soft dry cloth. Work another part next to the first and repeat until all of the stencil is fastened to the silk.

Allow the stencil to dry for five minutes. Start at one corner and peel off the waxed paper. Watch to see whether any part of the stencil failed to melt into the silk. If it did, press the loose part to the silk and dampen it again with thinner. Raise the frame slightly by placing a thin board under each side. With a cardboard for a squeegee, close the unfilled mesh of silk between the stencil and the frame with clear lacquer. Turn the frame over and place some paper tape next to the frame to keep the paint from leaking through along the edges.

Printing Posters

Place the frame with the stencil attached to the base. Insert the hinge pins, then locate and fasten the *register guides* by tacking them to the base on the left side and near the edge. Register guides are strips of cardboard 1½″ or 2″ wide placed so that the inserted paper will be in the proper position to receive the print.

The paint used for silk-screen work is a special one and may be purchased where other supplies are secured. A flat wall paint may be used if the oil is first removed. If this paint is still too thin, add a few spoons of cornstarch to each gallon of paint.

Place a sheet of cardboard 14″ x 22″, the size of the poster, against the guides on the base. Pour a good cup of the paint on the far or hinge edge of the silk. This is enough for a 16″ x 26″ frame. Place the squeegee back of the paint, tip the top slightly toward yourself, and with a slight downward pressure draw the squeegee in your direction with one continuous stroke. Raise the frame and remove the print. The prints cannot be stacked until the paint dries. Insert the next sheet and work the paint and squeegee toward the back of the frame for the second print.

Cleaning the Screen

It is *very necessary to clean the silk and the frame* when the job has been printed. The silk can be used many times if the paint is not permitted to clog the pores. There are several solvents that will do this work; the cheapest is kerosene. Turpentine can also be used but it is more expensive. The operator must be careful to clean the screen well when it stands for an hour or longer. To remove the stencil when the run is completed, apply a liberal amount of lacquer thinner to the top side of the silk with a brush or cloth. When it is loosened, the film will fall off the back. A new stencil may be applied after a few minutes.

Things to remember:

Secure a good grade of silk.
Purchase silk-screen paint for good results.
Have threads run parallel to the frame when mounting the silk.
Sharpen the stencil knife often on an oilstone.
Do not cut too deeply on the stencil.
Seal around the stencil with clear lacquer.
Seal around the inside of the frame with glued-paper tape.
Do not stack the prints.
Clean the screen well after each run.
Kerosene and gasoline, half and half, is good for cleaning.

In order to learn silk-screen work, the individual starts as a general helper. His pay averages about thirty cents an hour. After working several years, he may earn up to eighty cents an hour. When he has become familiar with the work, a man might be given the opportunity to become a cutter of stencils. The best-paid position is that of the designer or artist. Each artist is paid according to his own ability.

SUMMARY

Although it is a very old process, silk-screen printing has recently come into general commercial use for advertising and poster work. The advantages of this kind of printing are that it can be used on almost any material or on a surface of nearly any shape. The design is first cut on a special stencil which is attached with lacquer to a simple frame which is easily and quickly made. A convenient table top will serve as a base on which to use the frame. Special thick screen paint will give the most satisfactory results. Designs may be printed in several colors by making a stencil for each one that is desired.

QUESTIONS

1. Who were the first people to use silk-screen printing?
2. What type of work can be printed by this method?
3. What material is used for the printing fluid?
4. Is silk-screen printing more or less expensiv than printing from a press?
5. What is the name of the film one purchase for making a stencil?

6. What is the name of the device for pressing the paint through the silk?

7. How is a stencil removed from the screen?

8. What solvent is used to clean the paint from the screen?

9. What happens if the paint is not removed from the screen?

10. If you were paid 30 cents an hour as a helper and worked 7 hours a day for 5 days, what would your employer pay you at the end of the week?

TOPICS FOR DISCUSSION

1. My First Experience at Silk-Screen Printing.
2. How to Attach a Stencil to a Frame.
3. Cutting a Stencil for Silk-Screen Printing.
4. How Silk-Screen Printing Helps the Advertiser.

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CHAPTER X

ESTIMATING AND CUTTING PAPER STOCK

PAPER STOCK ESTIMATING

The cutting of paper stock is an important operation in the printing business because paper is an expensive material and makes up a large part of the cost. In order not to waste it, a printer must plan the cutting of his stock so as to get the greatest number of smaller pieces from the standard sizes in which paper is made. If he neglects this, he often finds that there is much waste which means a loss of profit on that job.

Some of the more common ways in which a printer figures his paper cutting are shown here. After the paper to be used has been selected, find the stock sizes that are on hand or can be ordered from a supply house. For the sake of explanation you find two sizes—*A* —32″ x 44″ and *B*—25″ x 38″.

Write the stock sizes *A* and *B* as two problems and below this the size of the printing sheet desired, 8″ x 11″.

First Method—Straight Division

Problem *A*	**Problem *B***
	1″ and 5″ waste
↑ 32 x 44 ↑	↑ 25 x 38 ↑
8 x 11	8 x 11
4 x 4 = 16 sheets	3 x 3 = 9 sheets

In *A* find how many times 8 is contained in 32 and 11 in 44. Write the answers below the respective numbers and multiply them together. This number, 16, tells you how many sheets 8″ x 11″ can be obtained from a 32″ x 44″ stock sheet. Follow the same procedure in *B* for the 25″ x 38″ size. You find that 9 sheets can be obtained, and that there are two pieces of waste, one 1″ wide and the other 5″ wide.

Check by the cross-division method to find whether the greatest number of sheets has been obtained from the stock sheet.

Second Method—Cross Division

Problem *C*	**Problem *D***
10″ and 4″ waste	3″ and 6″ waste
32 ↖x↗ 44	25 ↖x↗ 38
8 ↙x↘ 11	8 ↙x↘ 11
5 x 2 = 10 sheets	4 x 2 = 8 sheets

From the above answers, it is found that the greatest number of sheets can be obtained by cutting the stock sheet as in Problem *A* and by using the 32″ x 44″ size.

Estimating Waste Stock

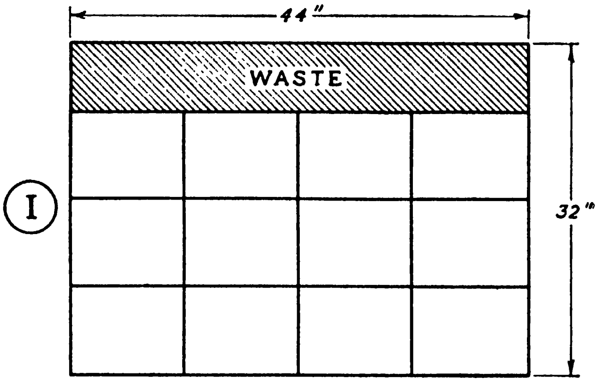
Waste stock is the paper left after the desired sheets have been cut. Many times this stock can be used for printing small jobs and should not be thrown away. To figure the waste, find out how much stock is left after the greatest number of sheets have been determined from the stock size.

Referring to Problem *A* we see that the 8 is contained exactly 4 times in 32 and 11 exactly 4 times in 44. As there is no remainder, there is no waste stock. In the case of the stock size 25" x 38" in Problem *B*, there is a remainder of 1" x 38" on the width and 5" x 24" on the length. When possible, cut the stock to get the most of the large-size waste.

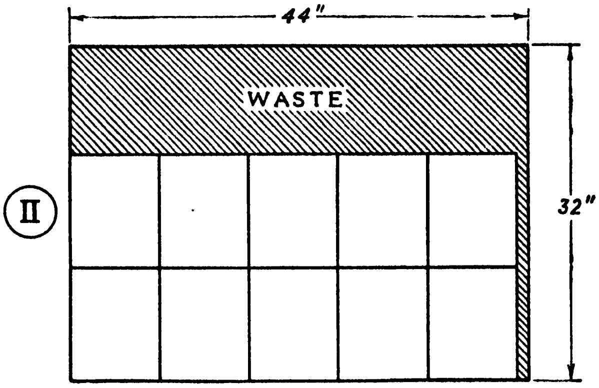
Estimating Paper Efficiently

It is often necessary to change from the usual method of making straight cuts across the two dimensions of the large sheets when cutting sheets that do not fit exactly the stock size from which they are to be taken. This gives the greatest number of smaller pieces and reduces the amount of waste to a minimum.

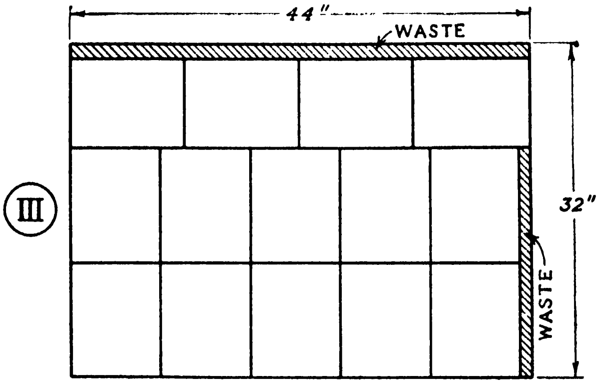
If it is desired to cut a 32" x 44" stock sheet into the greatest number of 8½" x 11" sheets and have the least amount of waste, estimate the number of pieces that can be obtained by the methods explained. This gives the number shown in drawings I and II. In both I and II there is waste, with II having the greater amount. After further measuring, it is found that the waste in II is of such a size as to permit cutting four more pieces of 8½" x 11" paper, but they must be cut in the opposite direction. This is shown in III. You can see the advantage of planning your paper cutting before actually doing it.



TWELVE SHEETS



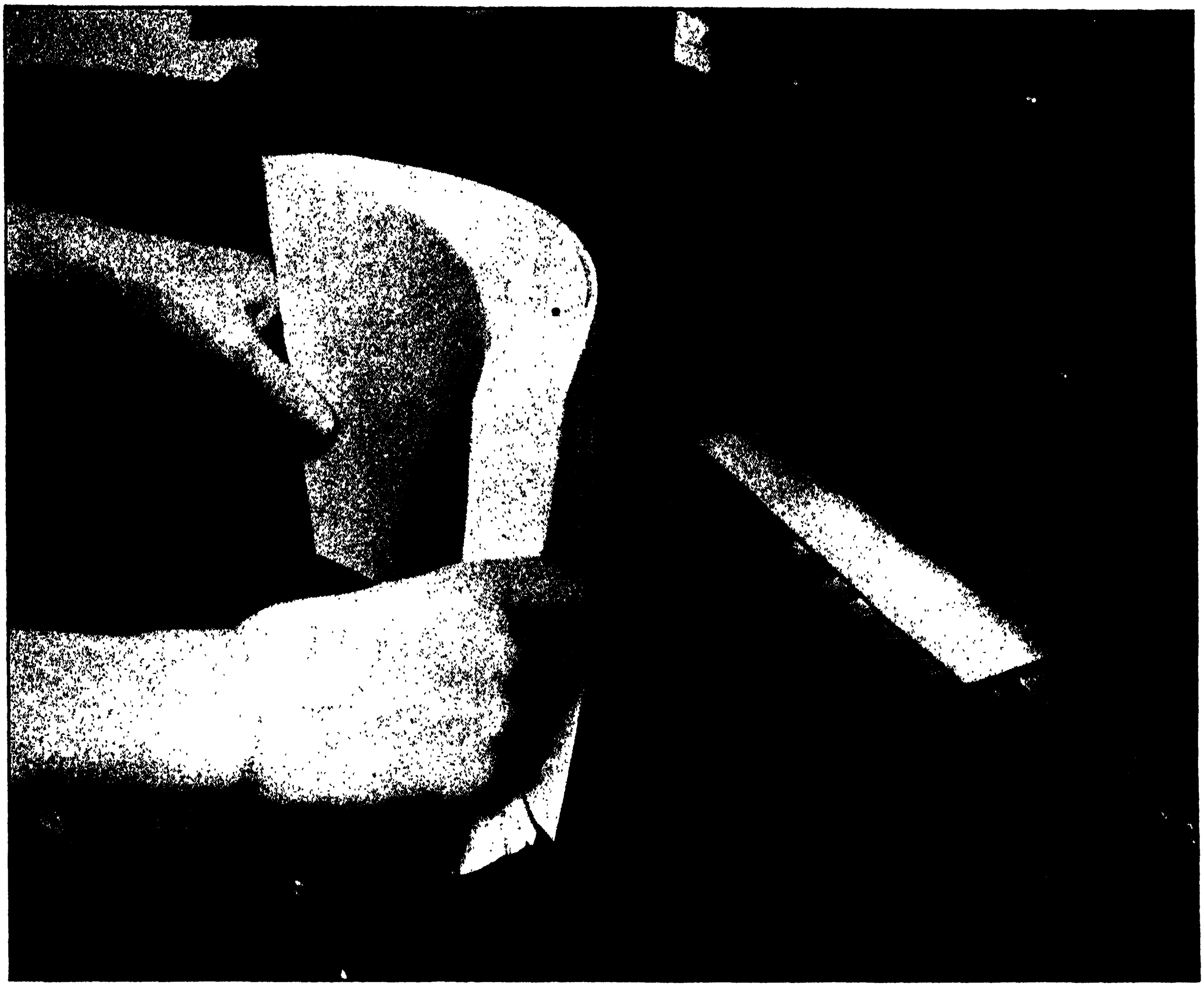
TEN SHEETS



FOURTEEN SHEETS

These exercises will help you to better understand the cutting of paper. Use the directions given and work the following problems which when completed should be handed to your teacher for checking. Use both straight and cross-division methods in each problem.

1. Find the number of 3" x 6" cards that can be obtained from a 24" x 36" stock of poster paper.



JOGGING A LIFT OF PAPER

2. How many 4″ x 9″ sheets can be obtained from an 18″ x 24″ stock sheet of book paper?

3. Explain which way you would cut a 23″ x 35″ stock sheet of cover paper so as to get the greatest number of 5″ x 8″ pieces with the least waste.

MACHINE PAPER CUTTING

The paper cutter is a very essential piece of equipment for the graphic-arts room. With proper instructions and permission the pupil should be given a chance to operate it.

The cutter consists of several parts. The *bed* upon which the paper is placed is perhaps the most important. At the back of the machine on the bed is located the *back gauge*. The back gauge adjusting wheel is located in front of the bed. On the right and left sides are found smooth straight strips of steel which are placed at right angles to the back gauge and are called the *right* and *left housings*. Above the bed is located the paper-stock *clamp* which is moved up or down by a wheel on the top of the machine. On the right side and in front of the machine is a large bar or handle that lowers the *cutting blade*. This blade may be

PLACING THE LIFT IN THE CUTTER

connected so that it is lowered by power delivered from an electric motor instead of using the bar or handle. There are other parts to a paper cutter, but these are the most important.

To operate the cutter, first see that the bed is clean and free of all rust, ink, and dirt so that the stock does not become soiled. Set the back gauge to the size the sheets of paper are to be cut. This is done by loosening the thumbscrew that locks the adjusting wheel. Turn this wheel to move the back gauge forward or backward. When the back gauge has been set at the proper distance, place one sheet of paper in the machine, bring down the clamp to hold the sheet in place, and lower the knife so that it will press a mark into the sheet. Remove this sheet of paper and measure it to see whether the machine has been set to the correct size. If it has, *lock the set screw* so that the adjusting wheel cannot be moved while working. Be sure to have the instructor check the cutter after it has been set.

In cutting stock, it is best to have a rather thick hard piece of cardboard above and one below the *lift,* or stack of paper being cut. The lower raises the paper slightly from the bed so that all sheets will be cut apart. The top cardboard prevents

CUTTING THE STOCK

creases and wrinkles from being pressed into the top sheets.

In placing a lift of paper in the machine, the sheets should first be *jogged* into place carefully. Jogging means to even one or two edges of a stack by lifting and dropping the stack of sheets several times against a table top while tapping the uneven top edge with the fingers. Blowing forcefully between the sheets on the top edge sometimes helps release sticking sheets. Place the stock on the bottom cardboard and slide the stack against the back gauge and over to the housing. To secure a right angle cut, it is important to have one edge against the housing and the other against the back gauge. It is desirable to place the best edge of the sheets against the back gauge so that the poorest edge will become the scrap or waste. Place the top cardboard in place and tighten the clamp so that it will hold the paper firmly. Do not place too much pressure on this clamp or the paper will be squeezed in a fan shape and the top sheets will be cut a little shorter than the rest of the paper.

So that the blade does not become nicked or damaged, printers have a rule that no metal is to be placed on or around the paper cutter.

SUMMARY

To avoid waste in cutting his paper stock for the many jobs he has to print, the commercial printer is very careful to estimate and plan the use of his large sheets so that he will get the greatest possible number of small sheets. Careful planning will often save much paper that would otherwise be wasted. This planning sometimes causes the printer to cut the large stock sheets in several different directions.

The large lever paper cutter is a most useful machine in cutting sheets for letterpress work, in trimming books, and in various similar jobs. Care must be used in setting and operating the cutter as the efficiency depends upon the sharpness of the cutting edge.

QUESTIONS

1. Why is the cutting of paper stock important to a printer?
2. How can paper stock that some people consider waste be used?
3. If a certain quality of paper were to cost 15 cents a pound and you purchased 27½ pounds, how much would your bill be?
4. What are three different parts on the paper cutter?
5. How can one check the paper cutter to see whether it has been set the correct distance?
6. What is a "lift" of paper?
7. Why are sheets of cardboard placed above and below a lift of paper to be cut?
8. Why are lifts of paper jogged before cutting?
9. A ream of paper has been damaged in shipping. Two inches must be cut off as waste for a print job. How should this ream be placed in the cutter?
10. What rule do printers have regarding laying composing sticks, bits of wire, type, or other metal around a paper cutter?

TOPICS FOR DISCUSSION

1. Placing Paper in a Paper Cutter.
2. What Our Paper Cutter Looks Like.
3. The Advantages of Figuring Paper before Cutting Stock Sheets.

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CHAPTER XI

SMALL DUPLICATORS

Inventors are especially busy designing and improving small machines for duplicating work in the business office itself. These machines allow firms to speed up their work and lower operating costs. The duplicators are not particularly expensive; and, in some cases, an office girl can operate them.

THE GELATIN-FILM MACHINE

The simplest low-cost duplicator is the gelatin-film machine. The gelatin is made chiefly of refined glue with some glycerin added. A thin film of this mixture is spread upon a cloth roll made by the cotton mills. Glycerin and glue are by-products of the meat-packing industry. The use of these products of two industries by a third shows the dependence of one industry upon others. This dependence is an important characteristic of modern living.

A special indelible dye is used for the duplicating. The indelible dye is made in pencil, ink, carbon-paper, or typewriter-ribbon form, and there are several colors of ink that can be used. The work is written or typed on a sheet of paper called the *master copy*. This master copy is placed face down on the gelatin surface for a minute or two and then removed. The indelible ink transfers from the master copy to the soft rubbery gelatin surface. A thin coating of ink sticks to the paper and makes from fifty to one hundred clear copies from one master copy. Order forms, business reports, sales reports, and salesmen's news letters are types of work done on the gelatin-film machine.

LITHOPRINTS

This type of duplication is used for the reproduction of maps, drawings, or office forms when small quantities are wanted at a low cost.

The machine consists of a table with a metal top upon which a special formula of chemicals is poured after they have been warmed. When this liquid touches the metal, it cools and forms a gelatinlike film. A blueprint that has been treated with special chemicals is then placed face down for a minute or two on the table top.

When the blueprint is removed, the surface is covered with printer's ink. Because of the chemicals the ink sticks only where the lines appeared on the original blueprint. Blank sheets of paper are placed on the film and the impression is transferred to them. From ten to thirty copies can be made before a new film of chemicals is necessary.

Tracing cloth, paper, cardboard, and white cloth can be printed; and several colors of ink may be secured. The work is said to be more lasting and clear than blue-prints. The product is a black or colored line on a white background. The finished job appears as if it were done on a printing press. The cost of Lithoprint work is low, amounting to about six cents a square foot when paper is used.

The machine costs $2000 to install. Most companies, rather than purchase a machine, mail their work to some individual who owns a Lithoprint just as they send their printing jobs to a print shop.

No special training is required to operate this machine, and no special salary is paid to those who use it.

PHOTOSTATS

The Photostat produces exact duplicates by direct photography in black and white on special paper. The machine, a large camera affair, takes the picture and prints and develops the entire work inside the camera, so that no darkroom is necessary. The Photostat copies the work either with a black line on a white background or a white line on a black background.

This device is used by many business firms to record their papers. The machine copies exactly from the original; therefore, no errors are possible. Because of this fact, courts accept photostatic copies as readily as they would original papers. Every department of the United States government has one of these machines. The value of such reproductions is that they may be made cheaply and quickly. They do not fade and cannot be erased.

The machine is so simple in design and accurate in reproduction that any intelligent person who is mechanically inclined can learn to operate it. Knowledge of photography is not necessary to use this machine, nor do you have to attend a special school to learn how to use the Photostat. There are many sizes and the cost is from $650 to $5000.

STENCIL DUPLICATORS

The Mimeograph is one of the common forms of duplicating machine for reproducing type- and hand-written material and simple illustrations. Practically every school system owns at least one such machine, and even small business houses can afford one.

The work is prepared on a stencil which is a thin tissuelike sheet coated with a plastic substance easily pushed aside. Much of the work is produced with a typewriter. A special device called a *stylus* is made for hand drawing on the stencil.

The stencil is carefully placed on the duplicator or metal cylinder. This cylinder has many small perforations through which the ink, which is semiliquid, flows into a cloth mat. Above this mat is stretched the stencil. It receives the ink on the underside from the ink-saturated cloth pad. Where the typewriter keys strike, the stencil coating is pushed aside. Ink oozes through these impressions to the outside of the stencil. Blank paper passes between a roller and the cylinder as it revolves with the stencil just touching the paper. The ink adheres to the blank paper to make the duplicates. The machine can produce about 200 sheets a minute.

To learn to operate this machine, you can go to the schools operated by the company that makes it. Or you may secure this information and skill in one of the larger high schools or business colleges.

There are several sizes and models from which to select. Some models are hand-operated; but the more expensive are run by a motor. The prices range from $37.50 to $700.

MULTIGRAPH

The Multigraph is a small machine for producing duplicated copies by relief printing. It is reasonably easy to learn to operate one, and the machine is used extensively.

Fundamentally the Multigraph is a cylinder to which either special metal type or plates in relief of rubber or metal have been fastened. The cylinder is revolved by a crank or an electric motor. The paper is inserted below the cylinder and receives the impression as the type touches it. Ink is put on the type either by using a rubber roller and printer's ink, or by the use of an inked cloth roll like a typewriter ribbon.

The machine is in two parts. The first unit is the typesetting device. It consists of a cabinet divided into many grooves in which the type characters are kept. The case looks somewhat like the change machines in the ticket offices at show houses. Letters are removed from the bottom by hand, using a kind of fork having two parallel prongs. The type hangs between these prongs and is transferred to the cylinder, the second unit, where grooves hold it in the proper place.

Letters may be assembled into words directly on the cylinder by a more complicated machine. It is hooked to a typewriter; and, as the typist writes, the letters fall down a tube and are placed in the grooves of the cylinder. After the type or plates are in place they are inked. There are several colored inks that may be used. The cylinder is revolved by a crank or motor, and blank paper passes below the type and receives the imprint.

Advertising and sales letters, bulletins, folders, and mailing forms are some of the different kinds of work done with this machine.

The manufacturer offers instruction in the operation and care of the machine, and any intelligent young man or girl can soon learn to run it. The machine costs from $180 for one that is hand-operated to $10,000 for a motor-powered one. It is capable of making from 1500 to 5000 copies an hour.

MULTILITH

Multilith machines reproduce work in a somewhat different manner from that of the Multigraph. The work is typed or drawn on a very thin metal plate or film. A special greasy ink is used on the plate for preparing the copy. This plate is then placed on a cylinder similar to that of a Multigraph and special ink is applied. This ink is prepared so that it sticks only to the part of the plate where the copy ink was placed. Water and chemicals have been applied by the machine to the rest of the plate so that no ink covers that section. The plate prints on another cylinder that is covered with a rubber blanket. The ink is pressed from the blanket onto the paper that passes below. This, as you have been told, is called offset printing.

The Multilith is a reproducing machine that you can learn to operate in several days. It does an excellent reproduction job. There are several sizes of machines and they cost from $380 to $3700.

SUMMARY

There are several small duplicating machines designed for general use in offices. These permit the business concerns to handle their own smaller jobs, such as records, advertising, sales letters, bulletins, and office forms. The least expensive of these devices is the gelatin-film machine which, however, produces only about one hundred copies from one master copy. The Lithoprint is chiefly used for reproducing maps and drawings when only a small quantity is wanted. One of the most frequently used of these devices is the Photostat which makes use of photography to secure an exact reproduction in black and white. Three other common duplicating machines are the Mimeograph, Multigraph, and Multilith. All make an excellent reproduction at a low cost per copy.

QUESTIONS

1. Where are glue and glycerin secured?

2. What advantages do the manufacturers of Lithoprint machines claim for the product of their machine?

3. What are some points in favor of Photostat reproductions?

4. How is the work put on a duplicator stencil?

5. Describe how the stencil works when it is placed on the machine for duplicating.

6. How fast can a stencil duplicator produce copies?

7. What does the Multigraph machine use to make the impression on the paper?

8. About how many copies can one secure from a Multigraph?

9. How does a Multilith work?

10. Where could you learn how to operate a stencil duplicating machine?

TOPICS FOR DISCUSSION

1. A Business Firm Should Own a Duplicator.
2. Operating a Stencil Duplicator.
3. Some Advantages of a Photostat.

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CHAPTER XII

BOOKMAKING

MAKING A SIMPLE BOOK

You will find bookbinding interesting. The work is not difficult and with care a neat volume will result. This book is made much like books in industry, but you will have to fold the sheets by hand instead of using machinery. When a company is trying to sell paper to a customer upon which to print a book, an exact duplicate of the proposed volume using blank sheets of the recommended paper is often made. This book is called a *dummy.* Your book will have blank sheets; so it too can be referred to as a dummy. It will have a cardboard cover with a decorative paper or piece of cloth covering it. Some boys use the books for stamp collections while others make autograph, address, or recipe books of them.

Pamphlets and books are printed on large flat sheets with the printing being done on both sides. These large sheets are then run through a machine where they are folded into groups of pages each in its correct place. Such a group is called a *signature* and contains from four to sixty-four pages. Books are made of many signatures sewed together.

To make your book you will need paper, waxed paper, cardboard, decorated paper or cloth, bookbinder's cloth, crinoline, thread, and paste. Plenty of water for washing your hands and a wiping cloth will help you to make a clean book. The tools you will use are pressing boards, a cutting board, a metal straightedge, four clamps, a nail, hammer, scissors, sharp knife, and a razor blade.

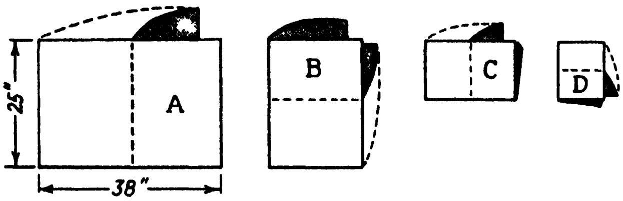
Making a Signature

Fold a sheet of 25″ x 38″ paper four times as shown in step 1 of the drawing. This will give sixteen leaves or thirty-two pages when cut apart. If sixty-four pages are wanted, fold two sheets of paper at the same time. You will find it interesting to take a sheet of notebook paper and fold it as shown. Now take a knife and slit the leaves that are fastened together at the top and bottom about two-thirds of the way towards the long folded edge which forms the back of the book. On the outside sheet write *Title* and below it *Page 1.* Number all thirty-two pages. Open the paper and you can see how the printer has to arrange his type so that the pages come in the proper place when the printed sheets are folded and sewed into book form. He has to print one group of pages, and after the ink dries the other group is printed on the opposite side.

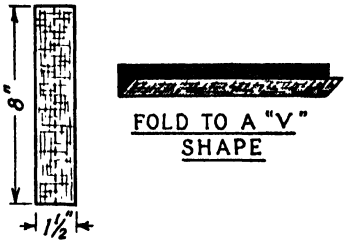
Sewing the Book

To fasten the book securely to the cover and to act as a hinge, the bookbinder uses

MAKING A SIMPLE BOOKLET

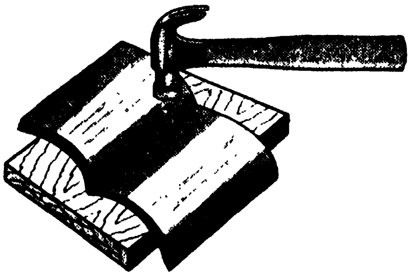


1. FOLD A SHEET OF PAPER FOUR TIMES (A,B,C,D) TO MAKE A SIGNATURE

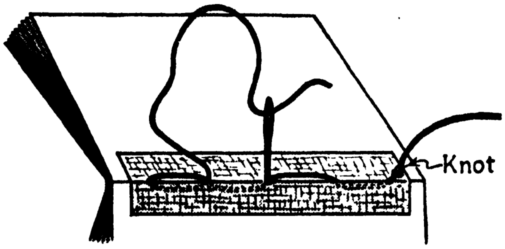


FOLD TO A "V" SHAPE

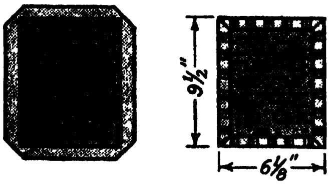
2. PREPARE A STRIP OF SUPER



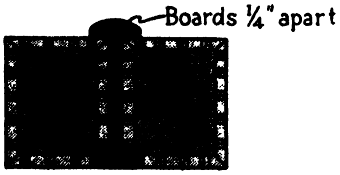
3. PUNCH HOLES FOR SEWING



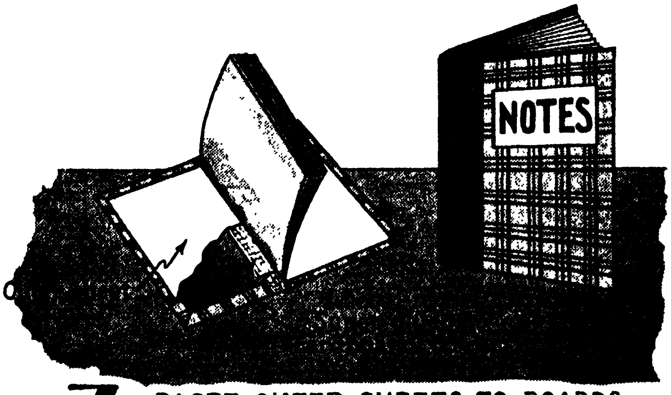
4. SEW SIGNATURE TOGETHER WITH SUPER ON BACK



5. COVER BOARDS FOR BACK WITH FABRIC OR PAPER



6. JOIN BOARDS WITH A STRIP OF BOOK LINEN



7. PASTE OUTER SHEETS TO BOARDS, COVERING FABRIC AND SUPER a coarse stiff cloth he calls *super*. Cloth almost like this can be purchased at department stores and is known as crinoline. If you have used paper 25" x 38" and folded it four times, the signature will be 6¼" x 9½". The super is sewed on the outside along the back. Cut it 1½" x 8" and crease it to a V shape as is shown. Take a thin nail and with a hammer punch five or seven holes in the fold of the signature to make it easier to sew the book. Do this on a block of waste wood. Do not get the outside holes closer than ¾" from the ends. See step 3. Secure a heavy thread, number 10 or 15, and sew the super to the outside of the signature as shown in step 4. Bookbinders use a strong linen thread made especially for them.

Trimming the Book

The book is now ready to trim. If there is a large lever paper cutter in your laboratory, use this machine after reading the instructions on pages 84 to 85. Trim ⅛" or ¼" from the top, bottom, and front of the book. This forms separate sheets. If there is no cutter place your book on a *clean* board. Lay a metal straightedge on top of the signature with the amount to be trimmed projecting. Clamp the straightedge in place and cut with a razor blade or very sharp knife until all waste trimmings drop away from the book. Do the other edges the same way. Scissors do a poor job because the signature is too thick.

Making the Boards

The two cover boards are made of cardboard covered on the outside with colored paper or cloth. These boards extend ⅛" beyond the three trimmed edges of the book. The cover board should come to within ⅛" of the back of the book. This space is left so that the covers will open. With a straightedge, clamps, and sharp knife cut the two cover boards the correct size.

Covering the Boards

A strong piece of colored paper or printed cloth as shown in step 5 is used to cover the boards. Cut the material about ⅜" larger all around and then cut off all corners as shown in the drawing. Fold the material that extends beyond the board up and over the inside surface. Have a tight fit to the edges of the board. Take out the cardboard and apply a coat of library paste over the entire inside surface of the paper used. When using paste, have water and cloth near to wipe the paste from the fingers. Use them often.

Place the cardboard in exact position, turn board and paper over and rub the paper tight to the cardboard. Be sure to cover the good paper with a protecting sheet of clean paper to prevent soiling. Reverse the work, apply paste to the projections and rub these down again, using the protecting paper. Paste the two sides in place first, then the top and bottom. Take care to fold the corners tight to the edges of the cardboard.

If cloth is being used instead of paper, the procedure is a little different. Have *all wrinkles* pressed out of the fabric. Cut the cloth ½" larger than the boards and clip off the corners leaving about ¼" of material. Apply paste to ½" of *one* long edge of the *board*. Bring the cloth up and press it down on the paste. Apply paste to the opposite edge of cardboard and paste the cloth to it. With the fingers pull the cloth tight so that there is no loose material on the front. Adjust the cloth while the paste is still wet so that the pattern is parallel to the edge. Paste and fold in the two corners at the top edge. Next paste the top edge to the board. Do the same with the bottom edge.

WIRE STITCHING IN A BOOKBINDING PLANT

Apply the paste to the cardboard in all cases.

A piece of bookbinder's cloth is needed to act as a hinge and finish the appearance of the back. Cut it with a razor blade and straightedge. Be sure you do not cut on the table top. The cloth should be about 1½" wide and lap inside the cover boards about 1". This is shown in step 6. Fold the cloth as it will be when pasted and mark pencil lines where the boards should be placed. Notice that they are ¼" apart. Apply paste to the bookbinder's cloth and paste it in place. Turn the assembled cover over and rub the cloth very tight to the cover boards.

Completing the Book

The signature and cover are now ready to be united. Lay the open cover on the table and stand the book upright on top of it. Draw lines on the cardboard just outside the super. Apply a coat of paste inside these lines so the cloth will be pasted to the cover boards. Some people prefer to first paste a sheet of wrapping paper to the two projecting pieces of super to stiffen it. Press the super cloth to the pasted surfaces and slip a sheet of waxed paper between this cloth and the book. This is done so the first and last sheets will not stick to the cover. Close the book to see whether all cover overhangs are the same. If they are not, slip the super about until the book is in the proper position.

Open the book again and rub a coat of paste on the top of the pasted super to make sure it will stick tightly. Replace the waxed paper and press the book between two boards for several hours using either clamps or weights.

Open the book once more, discard the waxed papers, and apply an even coat of library paste to the side of the sheet next to the cover board. It is best to first slip a piece of clean paper below this sheet so no paste will get on the rest of the book. With care close the cover on the pasted sheet, or *end paper*, and press it firmly down. Turn the book over so that the freshly pasted surface is below. Now, open the book about one half and rub the end paper tight to the cover. Rub the edges especially. A clean piece of paper placed on top of this pasted sheet before rubbing will help keep it clean. Do the same things to the other side. Press your book for several hours between two boards held with clamps and it is then ready to use.

MAKING A PHOTOGRAPH ALBUM

Many people take pictures for pleasure and find it convenient to have a book in which to keep them. Perhaps you enjoy this hobby and making an album will be of interest to you. By following the directions and drawings a splendid book for mounting your photographs can be made.

You will notice that the front of the book shown in the drawing has a hinged cover while the back is in one piece. This construction gives support to the pages and prevents them from turning down while the book is being held.

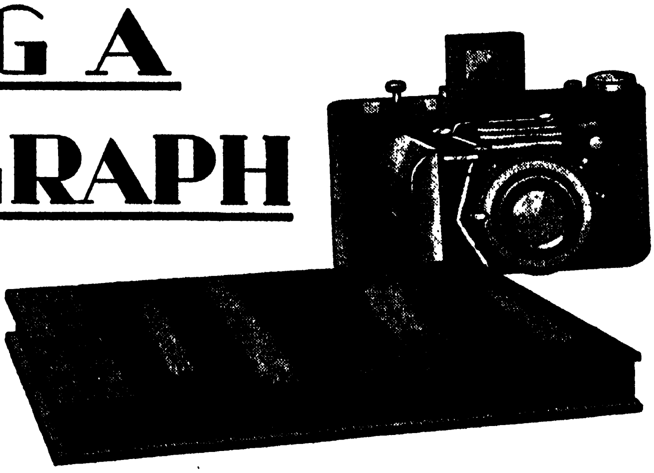
The materials needed are eyelets, bookbinder's cloth, cover boards of cardboard, super or crinoline, cover paper, library paste, and waxed paper. You will use the following tools: knife, straightedge, drawing boards, eyelet punch, ruler, and clamps or weights.

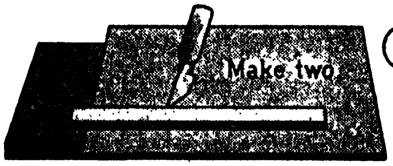
Secure two sheets of stiff cardboard and using a large try square or straightedge lay out the front and back covers which should be 8½" x 12". Cut the pieces with a straightedge and a very sharp knife. Either clamp the straightedge in place or have another boy hold it. Cut on a piece of wood so that the table top is not spoiled. If a lever paper-cutting machine is in the shop, ask your instructor if you may use it in place of a knife for cutting.

Measure and cut a piece of colored paper or bookbinder's cloth an inch wider and an inch longer than the cardboard. Place the back-cover board on this material so that all projecting parts are equal. Mark around the cardboard with a pencil and then remove the board. See the drawings for these details. Remove the cardboard and apply an even coat of library paste to the surface of the board that was against the paper or cloth. With care replace the cardboard and press it down. Turn the cover over, place a sheet of clean protecting paper on the outer surface, and rub the material tight to the cardboard. Do not allow wrinkles or air blisters in the finished job.

Now turn the cover so that the cardboard is up and fasten the corners. Study the drawing showing how to make a library corner. Apply paste to the four corners as shown and fasten them in place. Paste each projecting surface of material, then roll it over and against the edge of the cardboard and down on the inner surface. Press this down tight. Cut a piece of lining for the back cover from the same material that was used for the outside. It should come to within ⅛" of each edge. Apply paste and fasten the lining in place. Put a sheet of waxed paper over the lining and

MAKING A PHOTOGRAPH ALBUM





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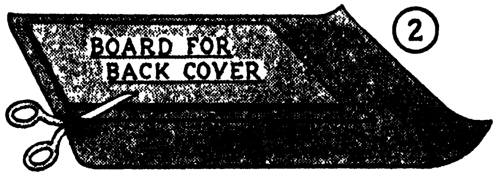
CUT CARDBOARD ON SOFTWOOD BOARD



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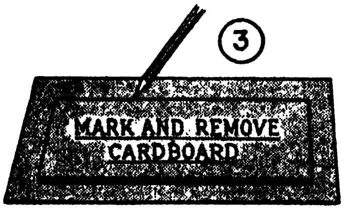
CUT BOOKBINDER'S CLOTH



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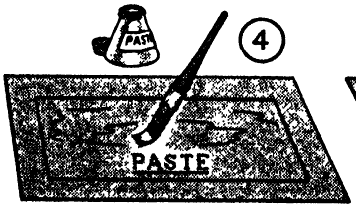

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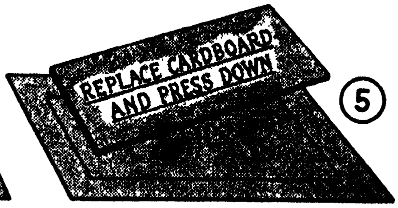

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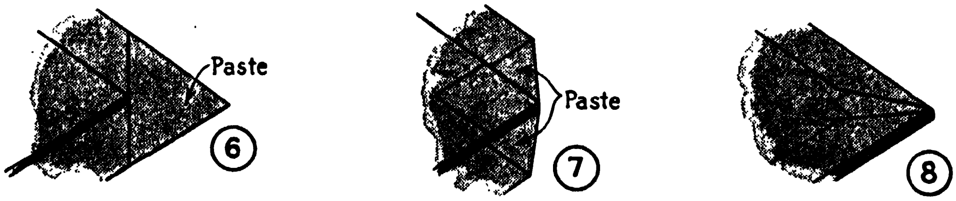
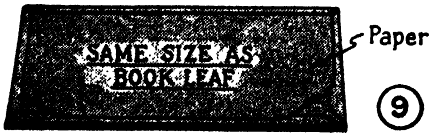


MAKING A LIBRARY CORNER



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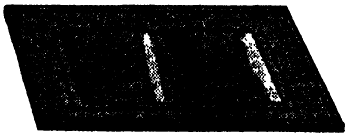
PASTE A LINING SHEET
INSIDE TO COMPLETE
BACK COVER



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POCKETS FOR LOOSE
PHOTOS

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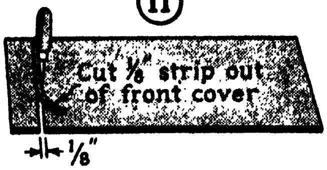
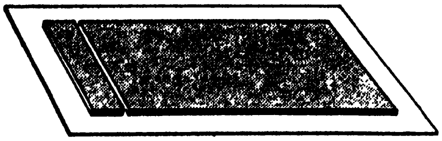
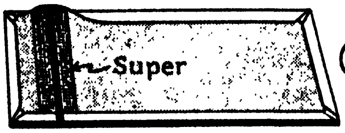


FRONT COVER MADE OF TWO PIECES

⑫



PASTE TO BOOKBINDER'S CLOTH WITH ⅛" GAP BETWEEN PIECES



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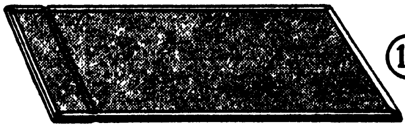
PASTE PIECE OF SUPER OVER GAP AND PRESS DOWN



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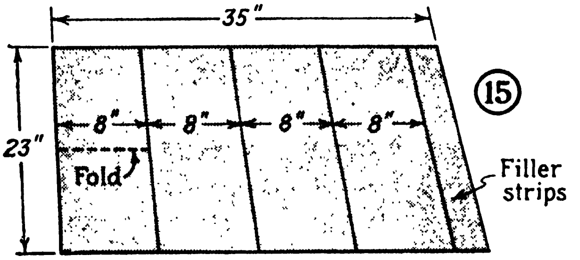
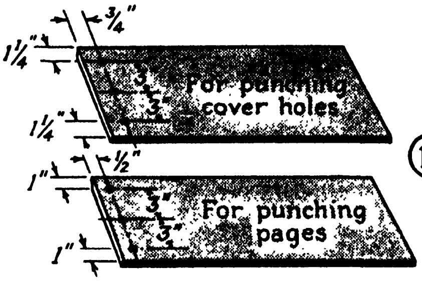
PASTE LINING SHEET TO INSIDE OF FRONT COVER

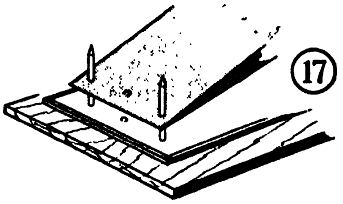


BLACK OR GRAY CONSTRUCTION PAPER

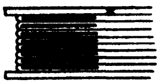


⑯

TEMPLATES FOR SPACING HOLES ACCURATELY



BOARD FOR ASSEMBLING PAGES



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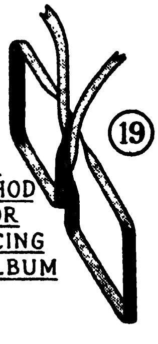
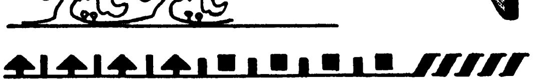
PLACE FILLER STRIPS BETWEEN PAGES TO PREVENT BULGING



A METHOD FOR LACING ALBUM

CORNERS



BORDERS

ABCDEFGHIJKLMNOPQRST
UVWXYZ

press between two clean drawing boards for several hours. Pockets may now be made and pasted to the lining.

To make the front cover, mark and cut out a ⅛″ strip 1½″ from the left edge of the second 8½″ x 12″ cardboard as shown in the drawing. You will see that there is a ⅛″ space to allow the cover to open easily.

Cut the outside covering material the same size as you did for the back. Lay the boards in place and mark around them with a pencil. Remove the boards and apply paste. Replace them on the material, turn the work over, and rub the cloth tight to the boards to remove all air blisters. Paste and turn the corners. Cut a strip of bookbinder's muslin, or super, 1½″ wide and 8½″ long. This piece is pasted over the ⅛″ opening to help form a hinge. Press the cloth in place and rub it down. Add extra paste to the surface along all edges if you think it might come loose later. With the narrow edge of a ruler press the cloth slightly into the ⅛″ opening.

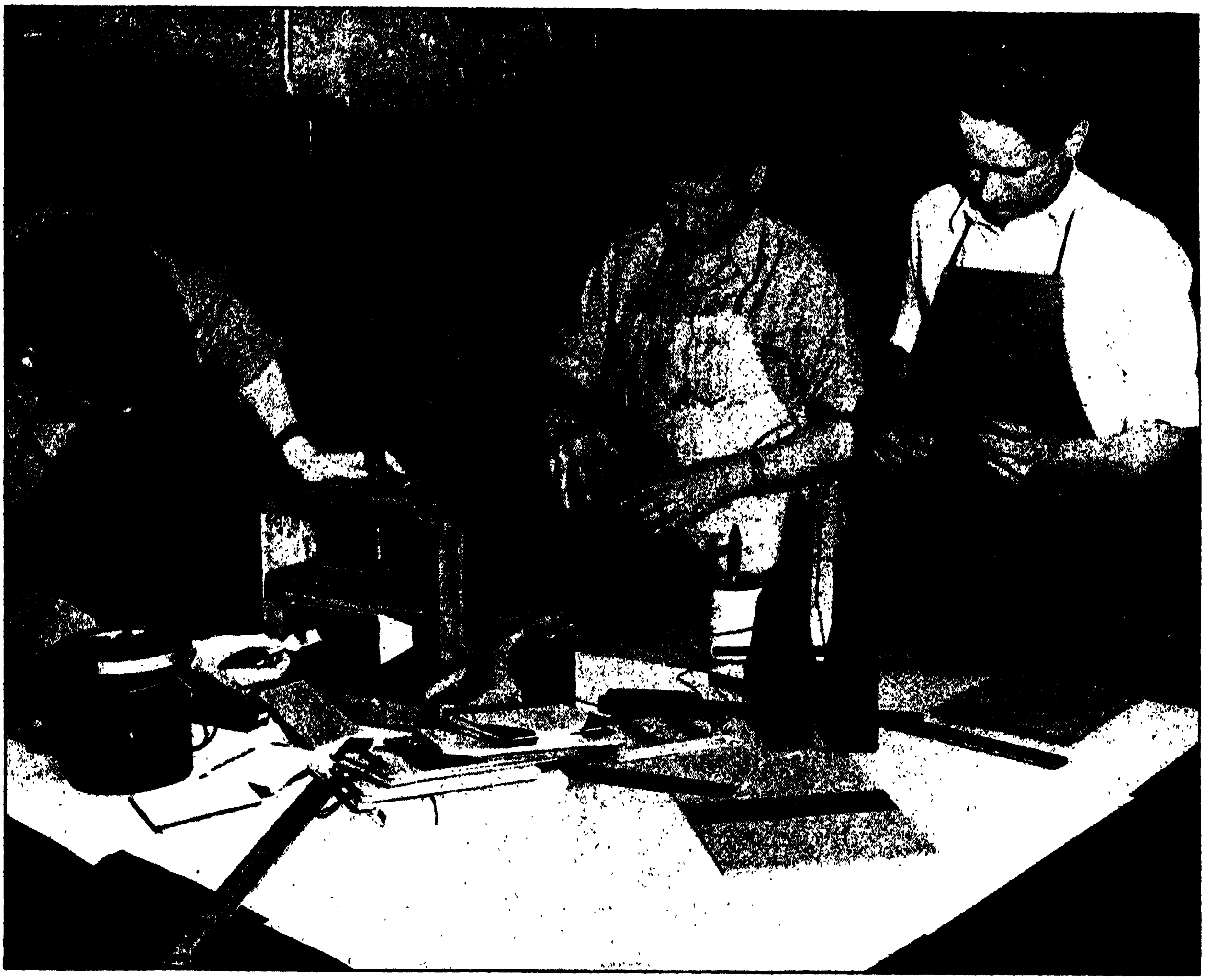
Paste the extended edges and press them into place as you did on the back cover. Line the inside similarly to the back, but press the lining into the ⅛″ space too. Place the cover between waxed sheets of paper and press for several hours with drawing boards and weights.

Eyelets, filler, and fasteners are now needed. So that all holes will be in the same place make a punching *template*. This is the mechanic's term for a pattern. It can be lightweight cardboard such as comes in shirts from laundries. Cut the template as wide as the book cover and 8″ long. Lay out the measurements for the holes as shown in the drawing. Hold this pattern or *jig* on the cover boards and punch the hole through each board separately. Keep the jig for use later. Place the metal eyelets in the holes and crimp or fasten them securely with the punch.

The proper size of paper for the photograph album is 23″ x 35″ with the grain running the 35″ way. Use three of these sheets for your album. Test each sheet of your paper to make sure the grain is correct. Carefully measure and mark the long side every 8″. This gives four 8″ x 23″ pieces and one 3″ x 23″ strip. Save the 3″ strip for making stubs which are inserted to prevent the book from bulging when photographs or clippings are pasted on the pages. Cut apart the four 8″ x 23″ pieces with knife or razor blade and straightedge on the cutting board. When cut, fold the four pieces at the center of the long side as shown in the drawing. With knife and straightedge cut each 3″ piece so as to make nine 1″ x 23″ filler strips. Cut strips 8″ long from these. This will make 18 strips 1″ x 8″. Now obtain enough of the same paper to make 5 more strips the same size. Check your material to see whether you have 12 folded, four-page sections 8″ x 11½″, a total of 48 pages, and 23 strips 1″ x 8″.

Holes to correspond to the cover holes must be punched in the filler strips and in the sections. Much care must be used here or the edges of the book will look uneven. Three sides of the template for locating the holes must have ¼″ cut from each. This is shown in the drawing on page 97. Use a knife and straightedge for cutting instead of scissors.

Punch the holes in the mounting sheets and filler strips using the template. Have another person hold the sheet and template while you punch. Insert a strip between the pairs and inside each of the twelve folded sections. *Jog*, shake and tap, the sections and strips to the edge so that the back will be even and each strip in place. If you have punched the holes correctly, each will be exactly in line with the others. Take the back cover and lay it right side down. Place the book filler on it and line



BINDING AND TABBING

up the holes by inserting a nail in each of the two holes farthest apart. Now place the cover on top of the filler.

To lace the book, study the drawing and then find the center of the lace by folding. Mark the center with chalk. Run the lace along the top cover and pass each end through an outside hole. Center the lace so that the chalk mark is over the center hole. Run each end along the bottom cover and up through the center hole. Pull the lace tightly and tie a bowknot around the lace running along the top cover.

Letter or place a design on the cover. Use your own ideas for decoration.

INDUSTRIAL BOOKMAKING

We are told that in former days only monks and some few nobles were able to read. For information and knowledge the mass of people had to depend upon what was told them by those able to read. Books were expensive to own, and only the churches possessed libraries.

Recall how the books of that time were produced. One of the monks read a few words aloud and then paused while a number of others copied the information. This method was very slow and not always accurate. Many hours were often spent designing and decorating the first or initial letter of each chapter. Beautiful and complex designs were used to add to the beauty of the book. All of this handwork added greatly to the cost of the book, or *manuscript* as it was called. Even the paper was made by hand. When completed, the books were sewed or bound together and had either a wooden or a leather cover placed on them for protection. How expensive books, papers, and magazines would be today if all of the work needed to make them were still done by hand!

But books are made much differently today. The author expresses his thoughts in handwriting or on the typewriter and sells the work to a publisher who prints the material as a book.

The paper on which the book is printed has perhaps come from Canada, Maine, or New York. It is made in mills that employ chemists who see that the paper is the kind and quality for which the publisher has asked. The publisher has conferred with scientists to find what type of paper will wear longest for the money he pays. He also has asked what kind of paper will be easiest for people's eyes while reading.

The publisher chooses type that he thinks people will like. He considers both size and particular design. The type is assembled either letter by letter in small shallow trays or by lines on a linotype.

After they are printed from this type in the pressroom the sheets are sent to the bindery.

BOOKBINDING

The bindery is a separate division of the printing industry. Here the printed sheets are folded, assembled in the proper order, sewed into books, and the covers glued. Some bindery jobs, such as magazines and catalogs, must be done as cheaply as possible and still be very rigid. These are stitched by using metal staples. Some of the large catalogs and telephone directories are assembled and a strip of cloth is then glued over the back with special flexible glue. Such glue makes it possible to open the book without cracking the back. The cloth acts as the hinge.

Many young men and girls are employed in the bindery. Girls feed the sheets into machines, sew books, inspect finished work, and take completed work away from the delivery racks. The men do most of the operating of the large machines necessary for bookbinding.

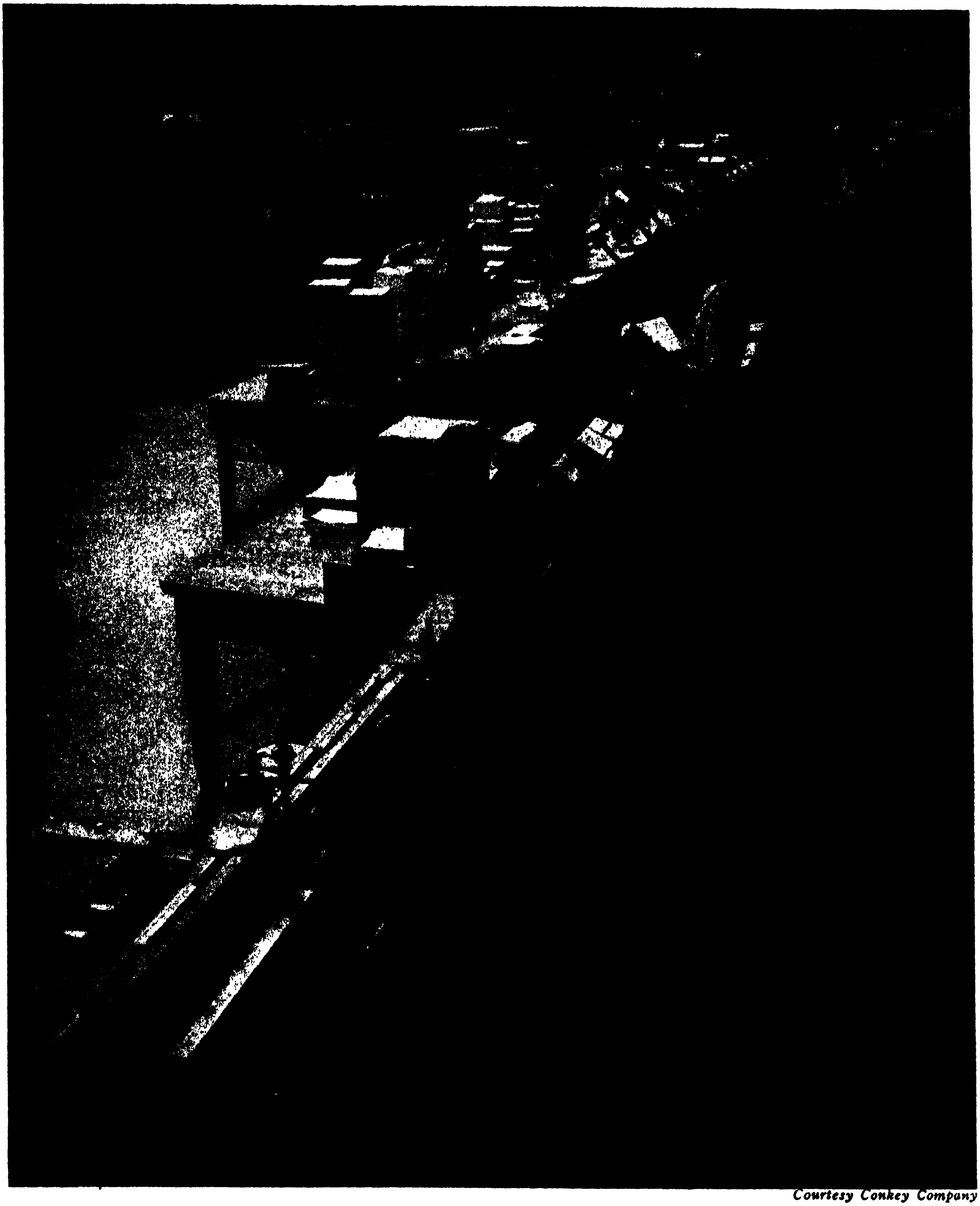
Hand-bound books require much artistic ability and skill, and we find that most of the men doing this type of work are older than those in many departments. They are people who have had much experience in bookmaking. People with their skills and knowledge are difficult to find; so their positions are more secure than are the positions of the machine bookbinders of modern industry.

Chicago and New York City are the big book-publishing centers in the United States. In these two cities there are many bookbinding firms, but several large firms bind most of the books.

Making a book is divided into two major parts, the presswork and the bindery work. A firm may do only presswork while a second firm does only binding. Some printing firms, however, do both.

Operations, such as *tabbing*, or gluing pads and tablets; punching holes for rings; rounding corners; perforating or punching many holes in a line as is done on sheets of stamps; pressing metal edges on papers as on the tops of calendars; ruling writing paper; and folding such things as road maps and railroad timetables are done in the bindery. Binderies sometimes mail their products to individual homes.

Bookbinding is itself divided into many operations. The reams of flat printed paper



Courtesy Conkey Company

GATHERING SIGNATURES BY MACHINE

are run through the folding machine and are then packaged. These packages are *smashed* by large pressing machines. This means that they are compressed to eliminate the bulge and air. The folded signatures are placed on a table for *gathering*, which means collecting the right group of sheets in the correct order so that they may be sewed into books. This gathering may be done by an automatic machine or by hand. The gathered signatures go to be *collated*. This is done by a person who checks to see that the signatures were placed in their proper order by the gatherer. If a picture or map is to be inserted this is now done by hand. It is held in place by a thin line of glue along the back of the sheet. Placing the glue on is called *tipping*. The sheets are now fastened together. They can be hand-sewed, machine-sewed across the back, or stitched together on the top surface by wire or string. Magazines are often fastened this way by using wire. Schoolbooks are often stitched with string to provide for hard use. This method is called *stab sewing*.

From this point on the bookbinder's operations are known as *forwarding*. The book is again smashed in a powerful press to take out the bulge. Then the *fore edge*, *head*, and *tail* are trimmed. This is the way workers in the trade refer to the edges of the book. One huge machine now being used performs all these operations, one after another, before the book is forced out of the machine. Some machines trim one edge only at an operation.

The back of the book is rounded by machine and special sheets may be inserted after they are tipped. End sheets are fastened on, headbands glued in place, and the book is then ready to receive its *case*, the cover, you call it. The cases are made by machine, and they are also glued to the book by machine. Before the case is applied to the book, a very large press prints the design and title on the flat case. Much pressure is given so that the design and words are pressed into the boards. Gold lettering is done after the case is glued into place. Some books have one or more edges stained, painted, or marbled. This is another operation done in the bindery.

The books are now ready for final inspection, packaging, and mailing.

Jobs in Industry

So that you may better understand the opportunities of the bookbinding trade as a source of employment, the following information was gathered from one of the largest bindery firms in October, 1940.

Girls and boys who have average intelligence and good health begin as helpers and feeders. They are paid from forty-five cents to about seventy-five cents an hour. The next place is as machine feeders. They operate machines for the first three years. After about four years with this firm, they are known as full machine operators and their pay is increased to between $1 and $1.25 an hour. Gatherers and collators are girls and women who are paid a *piece rate*. That is, they are paid for the amount of work completed each day. They earn about sixty cents an hour and work forty hours a week. Folder operators are all men, each running three machines at one time. They have risen to this position by showing their special talent for this kind of work and receive about $1.15 an hour. Each machine needs two bundle boys to carry the folded work away. They are beginners and may become operators later. The machine sewers are women and again piecework rates are paid. Case makers and casers-in are men who are paid about $1 an hour. Presser boys helping these men earn about seventy-five cents an hour.

SUMMARY

The making of a book is a fascinating and worth-while project. The signatures are folded and then sewed together. The back is then reinforced with super and the edges of the book carefully and evenly trimmed. The cardboard case is covered with a decorative cloth or paper to protect and beautify it. After the cover is fastened to the signatures, an excellent autograph album results.

A photograph album makes a convenient means of keeping your snapshots and is easily constructed. The method is similar to making a booklet. The chief difference is that the cover is attached to the leaves by lacing rather than by being glued.

QUESTIONS

1. Is each page of a book printed separately as a single unit?
2. What is a signature in bookbinding?
3. Describe what super is in bookbinding.
4. What is a template and how is it used?
5. Why are filler strips used in an album?
6. In what ways are pages of books fastened together?
7. What cities of our country lead in book publishing?
8. Making a book is divided into two parts. What are these?
9. What are meant by: smashing, gathering, collating, forwarding, and casing?
10. What is meant by *piecework* wages?

TOPICS FOR DISCUSSION

1. How Our First Books Were Made.
2. Bookmaking Machinery.
3. Workers in the Bindery.
4. Hand-Made Books of Today.

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CHAPTER XIII

MAKING A BOOK OF SEVERAL SIGNATURES

HAND BINDING

Few books are bound by hand today because of the cost. However, some people who have the necessary money and appreciate artistic work have paid from $5 to $500 a copy for hand binding. As a hobby, a few people cover their own books and books for their friends. They can do this because bookbinding is not difficult and does not require expensive equipment. In fact, it is fun; but one must be a careful, neat worker if a satisfactory job is to result. If you follow the directions here and work with care, you can make a book of which you will be proud. It may be used as an autograph, stamp, or reminder book.

You will first have to collect the necessary materials, most of which can be secured either from your instructor or at home. Glue, paste, thread, bookbinder's cloth, super or crinoline, wax paper, paper for the book, cardboards for covers, tape or one-half-inch cloth, printed cloth for headbands, cotton cord or heavy twine, and wiping cloths for the hands are the materials you will need. A needle, hand screws or clamps, sewing frame, thumbtacks, pressing boards, bone or wood folder, razor blades, shears, knife, paper cutter, hammer, and glue brush are the tools and equipment you will use.

These hints for good bookbinding will help you.

Do not rush a bookbinding job.

Clean books can only be made with clean hands and clean worktables.

Have plenty of cloth near for wiping the fingers free of paste.

Use sheets of Mimeograph paper or old newspapers on which to paste. Discard these papers often.

Spread paste evenly to the edges and corners of the sheets to be pasted.

When rubbing a pasted paper down, place a clean protecting sheet above the work—this guards against smears and finger streaks on the good surface.

Allow plenty of time for paste or glue to dry.

The knife must have a razorlike edge to cut cardboard properly.

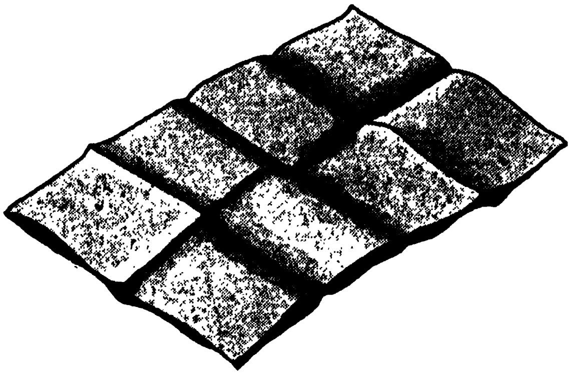
Making the Signature

To make your book, take a sheet of paper 17″ x 22″ and fold it three times as shown in the drawing. This forms one signature of eight leaves or sixteen pages, each about 5½″ x 8½″ when cut apart. If the larger sheets cannot be had, use 8½″ x 11″ paper, typewriter size, and fold each sheet separately. Then slip eight such folded sheets into each other to form a signature of thirty-two pages. Prepare as many sections as you wish in the book.

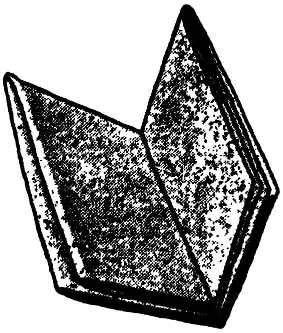
Fold the signatures with a bone folder if possible. This is a rectangular piece of bone with all sharp edges rounded. It slides over

BOOKMAKING

FOLDING SIGNATURES AND END PAPERS

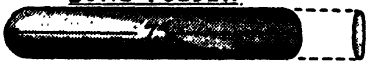


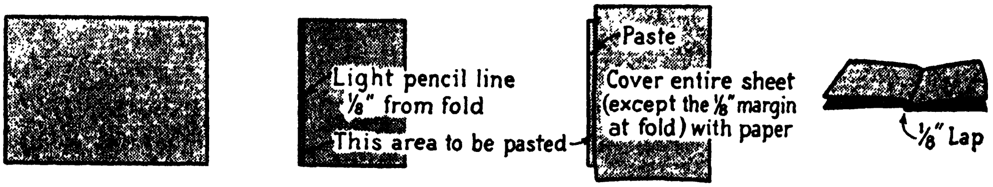
17" × 22" SHEET OPENED TO SHOW FOLDS



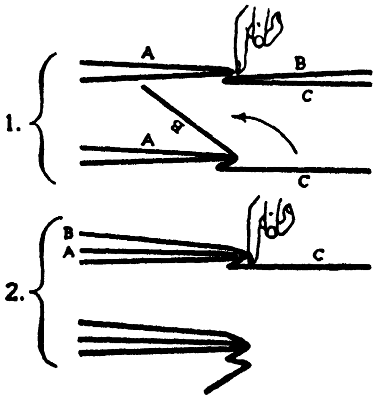
COMPLETED SIGNATURE
SIZE 5½" × 8½" MAKE 6 TO 10

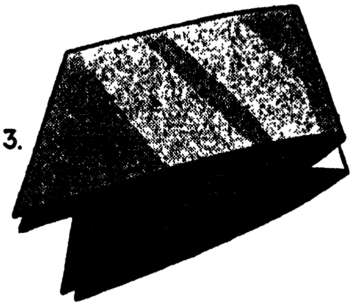
BONE FOLDER





FOLD FOUR 8½" × 11" SHEETS TO 5½" × 8½" - SPREAD PASTE ON FOLD AND FASTEN





the paper and creases it without leaving soiled spots. A substitute can easily be made from a piece of hard wood. The size and shape are shown on page 105.

Making End Papers

End papers, both front and back, are needed to complete the appearance of a book and may be made from four sheets of paper. This paper should be slightly heavier than that which you used to make the signatures and may be colored. If colored paper is chosen, select a shade that blends with the cover. The sheets must be twice the size of the folded signature. If you use $8\frac{1}{2}''$ x $11''$ paper, fold each sheet once so that it will be $5\frac{1}{2}''$ x $8\frac{1}{2}''$. Next to the folded edge of each sheet make a light pencil line $\frac{1}{8}''$ in on one surface only.

Cover all but the $\frac{1}{8}''$ of a sheet to protect it, and brush a coat of library paste on the exposed surface. Do this with the other sheet and place them together, pasted surfaces meeting as shown in sketch 1. Be sure they do not lap more than $\frac{1}{8}''$ and are straight along the bottom edge. With the thumbnail crease sheet B where it meets the edge of sheet A as shown in sketch 1. The crease causes the paper to fold more easily. Fold B up and over onto A as shown. Now crease C along the center lap where B was folded over as shown in sketch 2. Fold C under at this crease. This forms the accordion pleat which goes to the *outside* of the book on both the front and back. Look at the magnified sketch 3 to see this pleat. Make the second end paper in the same way.

Making the Sewing Frame

A sewing frame and clamping boards are necessary and can be readily made. Any kind of soft wood is used. The base of the frame is a rectangle $\frac{3}{4}''$ x $6''$ x $12''$. The surfaces should be planed smooth and clean so that the book will not become soiled. Two upright pieces are needed and may be $\frac{3}{8}''$ thick or more and $2''$ wide by $3\frac{1}{2}''$ long. The top is this same thickness and width. Fasten the uprights to the base with some $1\frac{1}{2}''$ nails. Now, lay the top piece along the base to see how long it should be. The top extends to the *outside* of both uprights. *Measure at the base.* After the top piece has been cut and smoothed with a plane, nail it in place. The sewing frame is ready for use.

The two clamping boards, or the *press*, are made of soft wood; and for $5\frac{1}{2}''$ x $8\frac{1}{2}''$ books they may be $\frac{3}{4}''$ wood about $6''$ wide and $12''$ long. They, too, should be smooth and clean when in use. These boards may be held in place with clamps.

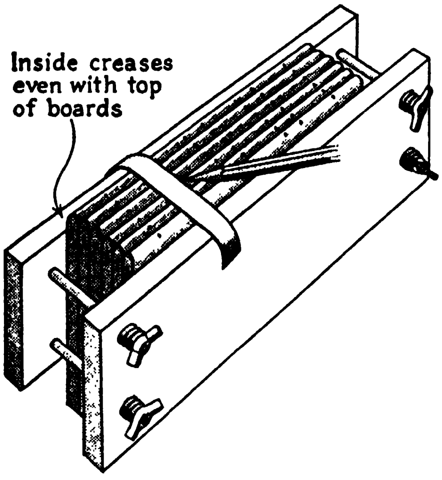
Some workers prefer to bore a hole near each corner and fasten and draw the press together with carriage bolts and wing nuts. If you wish to do this, place one board exactly on top of the other and mark an edge or end so that the boards will always fit together in the same way. Measure in about $\frac{5}{8}''$ from all corners; and, while the press is still together, bore $\frac{5}{16}''$ holes through both pieces. Purchase four $3\frac{1}{2}''$ carriage bolts and wing nuts to fit, with a dozen or more washers for adjustment. These clamping boards are used for sewing and gluing. The drawings on page 107 illustrate the construction.

Sawing the Signatures

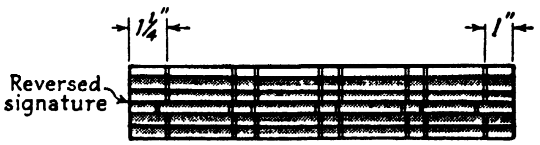
It is necessary to make several saw cuts on the folded edges of the signatures so that the needle may be pushed through the paper when sewing the sections into book form. If you study the drawing showing how a book is sewed, you will notice strips of cloth $\frac{1}{2}''$ wide pictured on the back of the book. These strips are known as tapes and may be purchased at a dime store. Their object is to strengthen the back, act as

BOOKMAKING

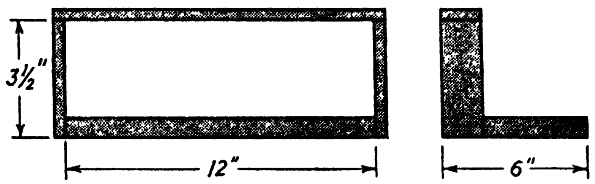
MARKING – SEWING



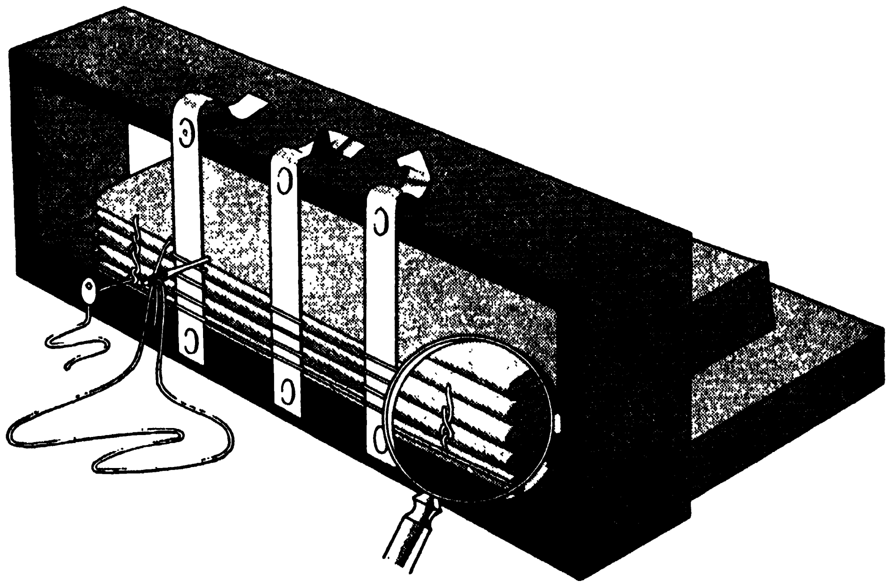
MARKING WITH PIECE OF TAPE FOR ACCURACY. BOARDS MAY BE CLAMPED OR FASTENED AS SHOWN



DRAWING SHOWING HOW A REVERSED SIGNATURE MAY BE EASILY DETECTED IF THE LOCATION OF THE END CUTS VARIES



CONSTRUCTION OF SEWING FRAME



hinges, and help hold the book to the cover. A saw cut is needed on each side of these tapes and near the top and bottom of the back, outside the tapes. Some books are made using cord or twine in place of the tapes; still others are made without either tape or cord.

Assemble all sections with the $8\frac{1}{2}''$ folded edges on one side, but *do not include* the end papers. *Jog* the folded edges or back so they are even. Place the signatures on one of the pressing boards with the fold on the inside exactly even with the edge of the board. Put the second pressing board on top of the group of signatures with care and clamp in place. The folded edges extend about $\frac{1}{8}''$ to $\frac{3}{16}''$ outside the boards and are ready to be marked for sewing.

Decide whether two or three $\frac{1}{2}''$ tapes are to be used. Choose one size. Place the clamped work in a vise; lay the tapes in place; and, using a try square, mark a line on each side of them. A line near each end should now be marked. Keep at least one inch from the ends and do not have the distance the same for the two marks. If your first mark is an inch from the end, have the second $1\frac{1}{4}''$ from the other end. This helps later in putting the book together correctly. The sketches show how to clamp and mark the work for three tapes.

Saw on the marks with a thin-blade backsaw or coping saw so that the cut goes just through the folded parts. *Do not go too deep.* Remove the signatures from the boards and open them to see whether there are small openings in the crease through which a needle can pass. If not, punch these holes through from the outside with a needle.

Sewing the Signatures

Assemble all sections and put the end papers on the front and back of the group. Be sure the accordion pleats are to the outside. Mark both end papers for holes to correspond with the saw cuts and punch the holes with a large needle. The book is now ready for sewing.

There are several methods of sewing. In your case it will be done by hand. In industry signatures are sewed by a special machine with girls doing most of the work. Sewing, shaping, trimming, and fastening on the covers is known in industry as *forwarding.*

Place the signatures on the sewing frame with as much space on the right side as on the left. Cut the necessary number of tapes about six inches long. Fasten them to the frame with thumbtacks, folding the bottom end over two or three times. Place one tack in the bottom board several inches beyond the left saw cut. To the tack fasten an end of the thread for sewing. The thread should be bookbinder's linen, which is very strong but not too thick. If you cannot get this, ordinary white thread will do. Use about number 10 or 15. Try to have the thread long enough to sew the job with one piece.

Lay an end paper *accordion pleat down* on the sewing frame. Open the paper where folded and sew back and forth. Sew around the tape and out the last hole on the right side. Pull the thread fast but do not jerk it tight.

Place one folded signature above the sewed end paper and sew it in the same manner toward the left. The upper section must always be tied to the one below it. This is done by using a *kettle stitch.* This is an easy knot and can be made as described. Push the needle halfway through between the thread and the paper where the thread first enters the end paper, near the tacked end of thread. Loop some of the loose thread over the top of the needle and pull tight to form a knot. Be sure the knot is close to the paper

A second section is placed on top of the first and is sewed. When the right end is reached, the kettle stitch must again be made. Drop down one section, slip the needle halfway through between the signature and the end paper starting inside the thread that holds both together. Loop the thread over the needle tip and draw the knot firm. Study the drawing.

Sew all sections in place and make the kettle stitch at the end of each. At the last, sew the other end paper in place with the *accordion pleat outside.*

Untie the end of string that was tacked to the edge of the frame and thread it to the needle. Make a kettle stitch with the signature directly above where the thread first enters the paper. Clip off the ends of string to leave about ¾″ on the work.

Gluing the Book

The book is beginning to take shape; signatures and end papers have been sewed into place. The back is now to be glued. Either a hot or cold glue of the kind used for wood will be suitable. The glue should be thinned about one half with water when used for bookwork.

Place one pressing board on a table and cover it with a sheet of waxed paper. Allow this paper to extend about an inch beyond one 12″ edge. This will keep the book from being glued to the wood. Jog the back straight and even; then place the book with care on the sheet of waxed paper. The back should be even with the edge of the board. Now place a sheet of waxed paper on top of the book. Put the second pressing board on and clamp everything together. It is not necessary to clamp it tight; only slight pressure is needed.

Brush a thin layer of glue on the back working it into the cloth tapes and out to the waxed paper. Pull the tapes tight so that all slack and wrinkles are removed. After the glue has dried several hours, give the back a second coat and allow it to harden overnight.

Trimming the Book

The next operation is trimming the edges of the book. This is best done in a large, lever paper cutter. If you have not worked with this machine, read the directions for its use in this book. The instructor will help you the first time. In cutting, the blade moves down and to the left. Glued surfaces should always be on the right. The blade in cutting will then press the glue tighter to the work. If the glue were on the left side, the knife might push or peel it off. Care must be taken to remove only as much paper from each edge as is necessary to make a straight even surface.

Rounding the Back

Notice the shape of a number of books. You will find the back rounded and the front edge curved inward.

Slightly soften the glue by dampening it with water for a few minutes. Lay the book on a *clean* table and with a rounded mallet or hammer pound on the back. Pound down and hook the hammer toward yourself while it is striking. At the same time push with the thumb on the front of the book. Turn the book over and repeat. Do this several times on each side and an evenly rounded back will result. Place the book away to dry while preparing other parts. *Do not open the book at this stage.*

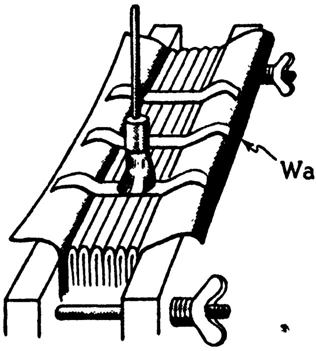
Making Headbands

Headbands are decorations made of cord and cloth. They used to be made of leather, laced and braided to the top and bottom of book backs for strength. Now they are only finishing decorations. Cheaper books do not have them.

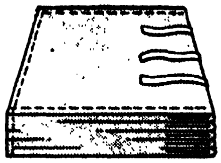
Get some printed cloth that will blend in color with the cover. It should be free of

BOOKMAKING

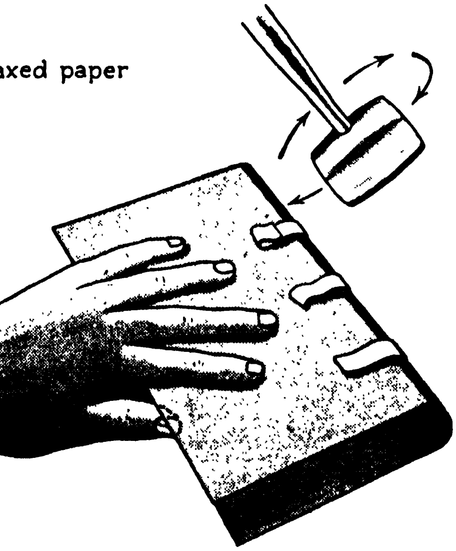
GLUING • TRIMMING • ROUNDING
MAKING HEADBANDS



GLUE ENTIRE BACK WITH HALF AND HALF MIXTURE



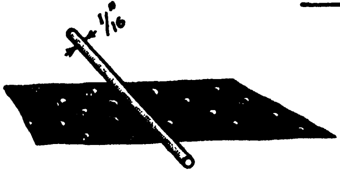
TRIM THREE SIDES ON PAPER CUTTER



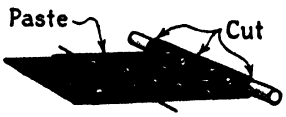
ROUNDING BACK

SOFTEN GLUE SLIGHTLY WITH WATER. PULLING END PAPERS WITH FINGERS AND PRESSING WITH THUMB, WHILE TAPPING WITH MALLET, RESULTS IN ROUNDED BACK

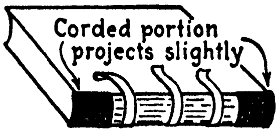
THE HEADBANDS



A PIECE OF DECORATIVE CLOTH AND A SHORT LENGTH OF CORD-



PASTED AND CUT-



MAKE A COLORFUL HEADBAND. GLUE IN POSITION AS SHOWN wrinkles, three times as long as the book is thick, and about two inches wide. Have some heavy twine or light cord several inches longer than the cloth at hand. Apply an even layer of library paste over the inside surface of the cloth. Now place the cord in the cloth and fold the material over the cord. With the fingernail, press a crease on one surface close to the cord. Cut two headbands from the piece. A razor blade is better than shears for this. Be careful not to mar the table top.

If the back of the book is now dry, clamp it in the pressing boards and paste the headbands in place as shown in the drawing. Library paste may be used. The cords extend just beyond the ends of the back.

Reinforcing with Super

To strengthen a book further, stiff cloth is pasted over the glued back. Bookbinders call it super. Storekeepers refer to it as crinoline. This super should fit along the back and about 1½″ out on each side. If your book is 1″ thick and 8½″ long, the super will be cut 4″ wide and about 6½″ long. Paste the strip to the back of the book using library paste. Rub the paste well into the cloth after the super has been put into place.

To help stiffen the super and tapes for pasting to the cover boards, add a strip of paper. Get a piece about the weight of brown Kraft wrapping paper. Cut it the size of the super that projects on each side. Lay the book on the table and place a sheet of paper over it so that you will not soil the end sheets. Spread paste over one surface of the reinforcing paper and slip it paste side up below the tapes and to the back of the book. Spread paste on both sides of the tapes. Bookmakers call them *slips.* Now press these slips against the pasted paper. Bring the super down to the reinforcing paper and rub extra paste into it from the outside. Now do the same to the other side of the book. Cover it with waxed paper and press for several hours until dry. Trim tapes, super, and paper to one size.

Making Cover Boards

Heavyweight cardboard can be used for the cover boards. Bookbinders use a grade known as *millboard,* but perhaps this cannot be had in the schoolroom. A good substitute is hard-pressed shipping-box sides from the grocery store or cardboard from a window display. The boards should be at least $\frac{1}{16}$″ thick.

Few books made in class are trimmed perfectly. Therefore each board is carefully measured so that the projections appear the same on all sides. Study the drawings and then you are ready to prepare cover boards.

Place the book on a sheet of millboard so that the back edge of the book extends ⅛″ *outside.* Measure and place a pencil dot on the board ⅛″ from the book near each corner. Draw lines through these dots and place a light identification mark near one corner on both book and board. Be sure the cover boards are later pasted so that the marks match.

Using a very sharp knife and a ruler, cut several times on the same mark until the pieces separate. Turn the book over, measure, place identification marks, and cut out a second board with the knife.

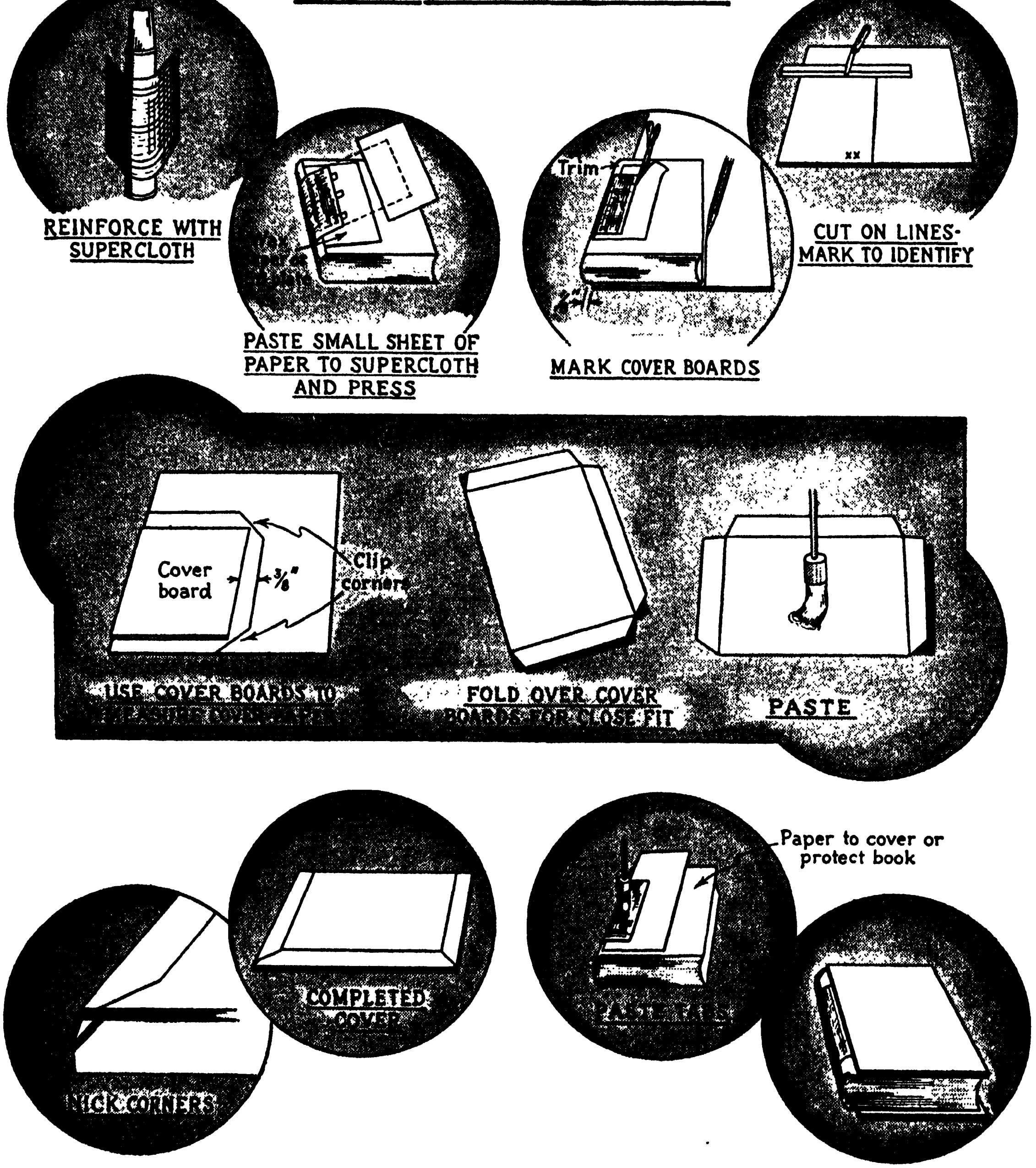
Placing the Boards

Some people add decorative paper or cloth to the boards after they have been pasted to the book. For a beginner, it is easier to do this before they are fastened. Colored paper makes good covering material. The following directions with the sketches should enable you to put the covering on the boards.

Lay a sheet of paper on the table and

BOOKMAKING

SOME FINAL STEPS


REINFORCE WITH SUPERCLOTH
PASTE SMALL SHEET OF PAPER TO SUPERCLOTH AND PRESS
Trim
MARK COVER BOARDS
xx
CUT ON LINES-MARK TO IDENTIFY
Cover board
3/8"
Clip corners
USE COVER BOARDS TO MEASURE COVER PAPER
FOLD OVER COVER BOARDS FOR CLOSE FIT
PASTE
NICK CORNERS
COMPLETED COVER
Paper to cover or protect book
PASTE TABS

place a board, *identification mark up*, on the sheet. The edge of the board at the back of the book should be even with one edge of the colored paper. Measure ⅜″ from three sides, connect the dots with lines, and cut out with shears. Clip the two corners about 3/16″ from the corner of the board as shown in the sketch. Fold the ⅜″ projections up and over the board and crease quite sharply. Remove the boards and lay the colored paper, good face down, on a sheet of pasting paper. Spread a generous even coat of library paste on the entire inner surface and work well into the paper. Discard the lower paper and press the board in place. Invert the cover and lay a clean sheet on the colored paper to protect it from finger marks. Briskly rub and press so the paper will be tightly pasted to the board. Be sure all air pockets are removed.

The top and bottom ⅜″ projections are next pasted into place. It may be necessary to repaste these edges. Be sure they are tight against the edges of the cover board when folding. The corners must be *nicked in* at the top and bottom of the outer edge. This means to paste the folded edge of colored paper against the outer edge. It is best done with a bone folder or the fingernail. Repaste the last projecting edge of colored paper if necessary, then fold and press into place. When both boards are completed, place wax paper over them and put them in the press to dry for a few hours.

The boards are to be fastened to the book. Care must be taken that each is placed on the correct side. The identification marks will help. Do not get the boards too far toward the back of the book or it will not open properly. Be sure the boards are attached evenly.

Lay the book on the table and place a clean paper to protect the end sheet. Spread a coat of paste on the 1½″ x 8½″ paper and the super tab made earlier. Invert the book on the proper cover board. Be sure there is ⅛″ left between the back of the book and the back edge of the cover board. Inspect all projecting edges of the cover for evenness and slightly shift the book if necessary. With care lift the book apart a little and press the tab tightly to the cover. Then lay a sheet of waxed paper in so the end will not stick to the cover. Do the same to the other side and place the book in the press to dry. Be sure the covers are protected by clean papers. After the paste has dried for several hours, you can again work on the book.

Padding the Book

A padding is needed across the back. Cut a piece of Kraft wrapping paper as long as the sheets of the book and three times the width of the back. Crease it in the long direction into three equal folds as shown in the drawing. Apply paste to the center section and place it in position on the back of the book. Slit the edges of both ends back about an inch to allow tucking in the back cloth later.

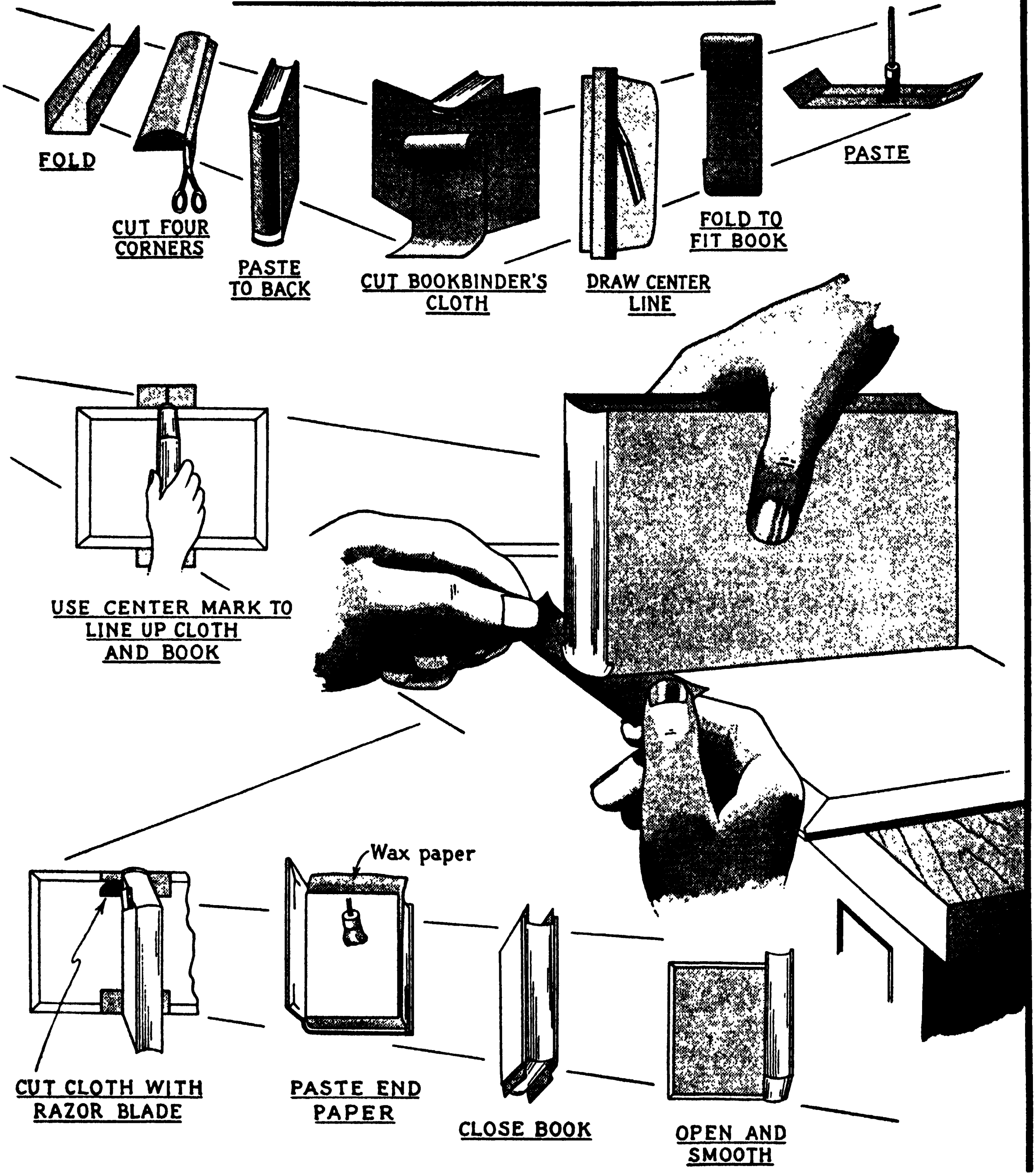
Preparing the Back Cloth

A trimming cloth is added over the padding. Cut a strip of bookbinder's cloth 1½″ longer than the cover board and wide enough to cover the back and lap onto both front and back covers. Three fourths of an inch to an inch and a quarter lap is good. Draw a center line down the cloth from top to bottom. Place it face up on the cover of the book and crease the cloth so the ends will be equal in length and inside the cover.

Place the back cloth on a pasting paper and spread an even coat of paste over the inside. Place the book with great care on the pasted cloth using the center line to get it straight. Rub the cloth tight against the back pad and over and down on the

BOOKMAKING

COMPLETING THE BOOK



cover. Be sure a clean sheet of paper is used to prevent smearing. Rub the other side the same way. Be careful not to leave any wrinkles.

Have another person hold the book upright with both boards flat on the table top. Bend the corners of the boards next to the book down slightly and slip the bookbinder's cloth into the back of the book between the padding. Press the cloth down firmly on the inside of the cover. It may be necessary to soften the paste with a fresh coat before doing this. Repeat the same operation on the other end. Crease the cloth tightly to the back edge of the boards by running the bone folder or fingernail up and down a dozen times or more.

Lining the Inside Boards

With a razor blade trim the excess bookbinder's cloth that is on the inside of the covers even with the turned in cover-paper edge. Measure a piece of drawing or construction paper so that it will exactly fit inside the tab that holds the book to the cover boards and the turned-in edges of the cover paper. Paste this sheet in place. It should make the inner surface of the cover level and even.

Open the cover, slip a sheet of pasting paper below the first end sheet, and apply a coat of paste to the end sheet. Remove the paste paper carefully and close the cover board slowly. Open it again and check the position of the end sheet. When in the correct place, lay a clean sheet and rub the end paper tight to the inside of the cover with the fingers. Put a sheet of waxed paper in, close the book, and do the same to the other side. Put clean sheets of paper on both covers and clamp the book between the pressing boards for a half day.

This book should be a fine one if all directions have been followed closely and carefully.

BINDING MAGAZINES

Magazines come from the publisher with a soft and inexpensive cover which allows the edges and corners of the pages to become bent or rolled. Because the contents of some magazines are valuable for reference, many people have their copies bound with stiff covers to protect them. You can easily learn to do such binding. Usually we do not do as costly a job of binding magazines as we do books because of the difference in value.

Some publishers print indexes every six or twelve months that may be secured for binding with their copies. The index helps you to find articles quickly. If the index is printed once a year, use the twelve magazine issues with the index and bind them into one volume. Two volumes can be made if the index is printed twice a year.

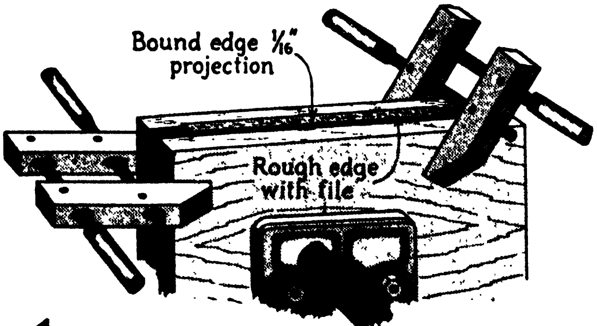
If the magazines have rounded backs and are stapled in the center of the back, the best method is to remove the staples and sew the issues on tapes or cords. Where the signatures are square at the back of the magazines and are held together by wire staples driven through from top to bottom along the back edge, another way is possible.

Paste, pasting paper, glue, wiping cloth, a pan of water, cardboard, covering paper, lining paper, super or crinoline, cord, and waxed paper will be needed to bind your magazines by this method.

Ruler, straightedge, razor blade or sharp knife, scissors, saw, two pressing boards, clamps or weights, a paste brush, wood file, pliers, screw driver, and four pieces of clean tin plate are the tools with which you will work.

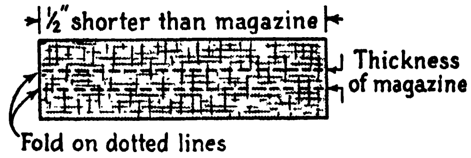
Take the magazines apart by removing the cover and staples. With the aid of a sharp knife remove any advertising that is not wanted in the bound volume. Some people keep one printed magazine cover to

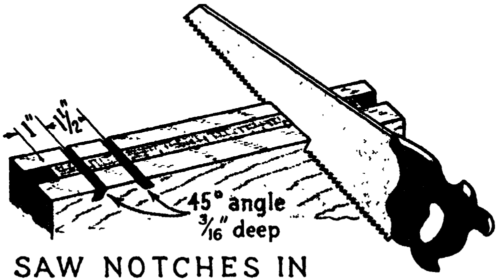
BINDING A MAGAZINE



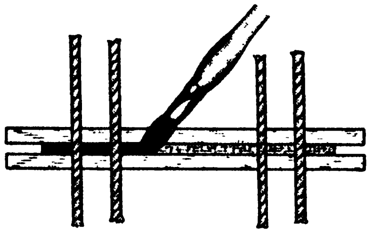
1. CLAMP MAGAZINE BETWEEN TWO BOARDS; PLACE IN VISE

PREPARE A STRIP OF SUPER

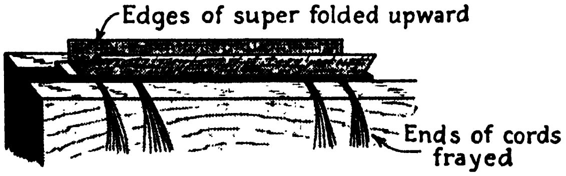




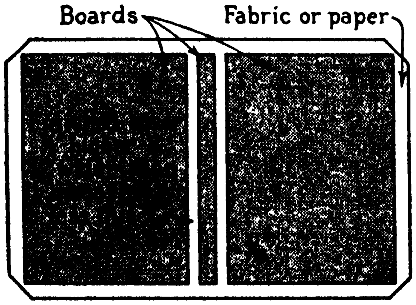
2. SAW NOTCHES IN BACK FOR HINGE CORDS



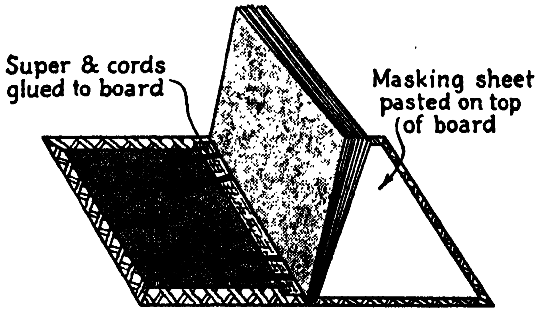
3. PUT CORDS IN PLACE BRUSH GLUE ON BACK


Edges of super folded upward
Ends of cords frayed

4. PLACE SUPER ON BACK; APPLY ANOTHER COAT OF GLUE



5. PREPARE THE COVER


Super & cords glued to board
Masking sheet pasted on top of board

6. ATTACH MAGAZINE TO COVER

decorate the front of the bound job when completed.

Prepare two sets of end papers for your binding and place them away for later use.

Place a sheet of waxed paper on a pressing board so that it extends about 1" beyond one long edge of the board. With care place the index on top of the waxed paper. Place each copy of the magazine in its correct position. Place waxed paper on these. *Collate* the assembled work. This means to check each sheet for its proper place and to see that no pages are turned end for end.

Place the second pressing board on top and jog the whole thing even along the back edge. Lay the unit down and clamp it together taking care not to squeeze it too tightly. This is shown in drawing 1. Then place the work in a vise and file the whole surface even. This roughs the paper a little so the glue will make all sheets stick.

Notches for the binding cords are now sawed. Four, five, or even six cords can be used. Do not locate the outside cords too near the top and bottom of the back. See the illustration.

While the magazines are still clamped, brush a mixture of half glue and half water well into the back of the magazines. Be sure the glue is worked out to the waxed paper and down into the saw cuts. Cut cotton cords that are about $\frac{1}{8}''$ in diameter long enough so that they will go across the back and extend at least 2" out on each side. Slide these cords into place and brush glue on them where they run through the saw cuts. Press them well down into the cuts with a screw driver or other blunt tool.

Cut some super or crinoline $\frac{1}{2}''$ shorter than the length of the magazine and wide enough so that it will extend $1\frac{1}{2}''$ on each side. This will hold all the sheets together and is used to fasten the magazines to the covers. Mark the place the magazine will occupy on the super and fold on these lines. Lay this U-shaped cloth on top of the glued back and brush a coat of glue on the super. Allow the glue to harden several hours. While the glue is setting, dampen the cotton cords and unravel them into single strands. The volume is now ready for trimming. Remove the pressing boards and waxed paper. Trimming is best done in a large paper cutter. Trim just as small an amount from the three loose edges as is necessary.

If desired, the back of your book can be rounded. As this binding is not as strong as a sewed book too much pounding is not recommended.

The case or cover is prepared while the glued part is drying. It is made by pasting two pieces of at least $\frac{1}{8}''$ thick cardboard on bookbinder's cloth or decorative paper. Mechanical-drawing paper does very well for the cover paper and is serviceable. A piece of cardboard, such as comes from the laundry, is pasted down the back to protect the back of the book. A $\frac{3}{16}''$ space is left between this and the boards so that the case will close. These details are shown in drawing 5.

Prepare the $\frac{1}{8}''$ cardboards by cutting two as wide and as long as the magazine has been trimmed. Add $\frac{3}{16}''$ or $\frac{1}{4}''$ to the length for the overhang at the top and bottom. Add an equal amount for the overhang at the open side of the book and then subtract $\frac{3}{16}''$ for the part where the boards do not come back to the centerpiece. Of lighter-weight board, cut the piece to go over the back of the volume. It should be exactly as wide as the volume and as long as the case boards. A very sharp knife, a metal straightedge, and a piece of soft wood are best for cutting this heavy cardboard. Cut over and over in the same place until the cardboard separates by itself.

Lay the three pieces of cardboard on the material selected for the outside cover with $\frac{3}{16}''$ between the centerpiece and the outside boards. With care mark a pencil line around *each corner* of each board. Measure on the material $\frac{3}{4}''$ out from the boards and draw lines. With shears or a knife trim the material to size. Apply a liberal but even coat of library paste to the center board and press it into place. Wash the paste from the fingers often with water. Have clean hands. Turn the whole unit over and rub the cover material tight to the pasted surface. A sheet of clean paper placed on the work will help keep it unsoiled while rubbing it to the paste.

Apply paste to the "down" surface of one case board and press it into place. Rub the decorative paper to it in the same manner. Do the same to the last board. Clip the corners of the decorative paper as shown in drawing 5. Apply paste to the top edge and press and roll it against the edge of the boards and down onto the surface. Do the same with the bottom projection. This is shown at the left cover in drawing 6. Paste and press into shape the right and left projections. The cover should be pressed between two boards for several hours. Place waxed paper between the boards and the cover and use clamps or weights for pressure.

Have some friend help you fasten the volume to the case. Ask him to hold the bound volume on top of the cover in a vertical position as shown in drawing 6. Trace around the super cloth on both boards. Remove the volume and spread a liberal amount of library paste on the board inside the pencil marks. Return the volume and press the super to the paste. Lift the super on the other side, spread paste on the board, and press the super cloth to it. Lift a frayed cord, spread paste on the board below it and then press the cord fan-shaped to the paste. Apply paste on top of the cord and rub it in well. Do this to all the cords.

Now press the volume several hours. First slip a sheet of tin plate inside each cover and one outside each cover so that the paste will not stick where not wanted. Place the whole thing between the pressing boards and apply pressure with clamps or weights.

The end papers are now ready to place in the front and back of the binding to trim the appearance. With scissors cut the end papers the exact size of the volume. Place a sheet of clean paper larger than the end papers between the sheets. Have the one with the accordion pleat facing up on the table. Spread a liberal amount of paste over the entire outside of the piece having the accordion pleat. Along the hinge edge on the reverse side spread a $\frac{1}{16}''$ line of paste so that it will stick to the first page of the first magazine. This is called *tipping* the sheet. With the aid of a sheet of tin plate push the pasted end sheets back to the hinge line. Press the pasted paper (it can be called the *masking sheet*) down to the board. Do not leave wrinkles or air blisters. Do the same with the other side. Place a sheet of tin plate inside and outside each cover and press the work overnight.

If a magazine cover was kept, trim all four edges. Paste this cover on the front of the volume you have just bound.

SUMMARY

Hand binding is one of the most interesting parts of the bookbinding industry. An artistic and satisfactory cover is obtained with careful work. The first step is the making of the signatures. End papers add to the appearance of the book and are easily made. The signatures and end papers are sewed onto tapes and the book is glued. After trimming, the back is rounded and decorative headbands are added. To strengthen the book, super is attached. Cover boards are made and decorated to form the case. After padding the back the case is glued to it to complete the book. Magazines may be bound in a similar manner to make a permanent addition to your library.

QUESTIONS

1. Why are tapes used in making a book?
2. Can books be made without tapes?
3. What is meant by forwarding in binding books?
4. How do you sew a signature?
5. Why is a sheet of waxed paper used between a freshly glued or pasted part of a book and the pressing boards?
6. Is it correct to place the glued edge of a book to the left in a paper cutter for trimming? Why?
7. When a book or magazine is collated what is done?
8. How does magazine binding differ from bookbinding?
9. Why are sheets of tin used between the printed matter and the cover when pasting?
10. Are the cords used when binding magazines?

TOPICS FOR DISCUSSION

1. Gluing the Back of a Book.
2. Trimming My Book in a Lever Paper Cutter.
3. Headbands for Books.
4. Binding Magazines.
5. Materials and Tools Needed to Bind My Book.

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CHAPTER XIV

PAPERMAKING

PREPARATIONS FOR AMATEUR PAPERMAKING

Much of the hand-made paper used has come from France, Italy, and Spain. You, too, are going to make paper in your own shop. The only equipment that needs to be made is a mold, deckle, paddle, and masher. The mold and deckle make a frame to form the paper, the paddle is used to stir the pulp, and the masher breaks up the fibers

Making the Mold and Deckle

Use ¾″ thick soft wood and make two rectangular frames 9″ x 12″. The wood can be 1″ or 1½″ wide. Fasten the corners of each frame by using butt or half-lap joints. Cover the mold with fine mesh copper screen using copper tacks for fastening. Fold under the raw edges of screen.

Locate four locking-pin holes by placing the deckle above the mold with the screen side up and clamp it in this position. Bore four ¼″ holes through both frames, one in the center of each side and end. Insert a ¼″ dowel pin in each hole of the deckle permitting it to project into the mold ½″. Nail the dowel pins tight in the deckle and file them bullet-shaped on the end. Also file them so that they fit loosely in the mold holes. This is necessary since wood swells when it becomes wet.

Making the Paddle

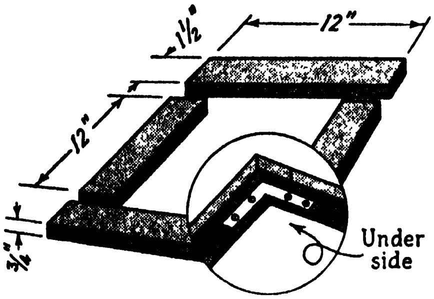
Secure a piece of wood ¾″ x 4″ x 24″. Then take a piece of wrapping paper the same size to make a template. Fold the paper edge to edge and crease it flat. Draw one half of the handle design 6″ from one end, cut the template, and trace the pattern on the wood. Using woodworking tools, cut the paddle to shape and sandpaper it.

Making a Masher

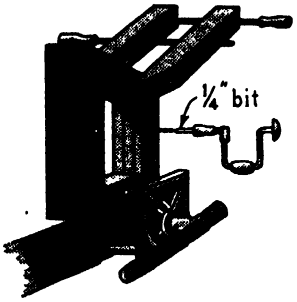
Secure an empty medium-sized tin can open on one end and a piece of broom handle about two feet long. If you bore several small holes through the part of the handle that extends into the can and slip large nails through the holes, the handle will be held more securely in the concrete. Mix some concrete to give weight to the masher. Place the handle in the open tin can and pour the concrete around it. Be sure the handle is straight while the concrete is setting.

Concrete is made by using one part cement, two parts sand, and two or three parts of small gravel. Mix these together thoroughly in the dry state and then add about as much water as cement. Do not have the concrete sloppy and allow it to dry for several days before using the masher.

MOLD AND DECKLE

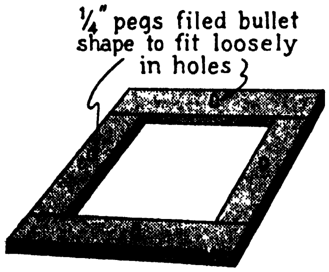


FRAME FOR MOLD OR DECKLE

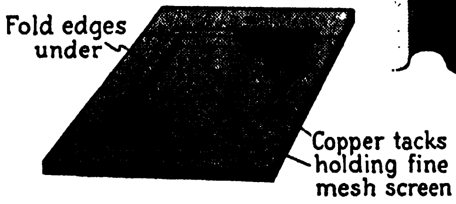


METHOD OF HOLDING FRAMES FOR DRILLING

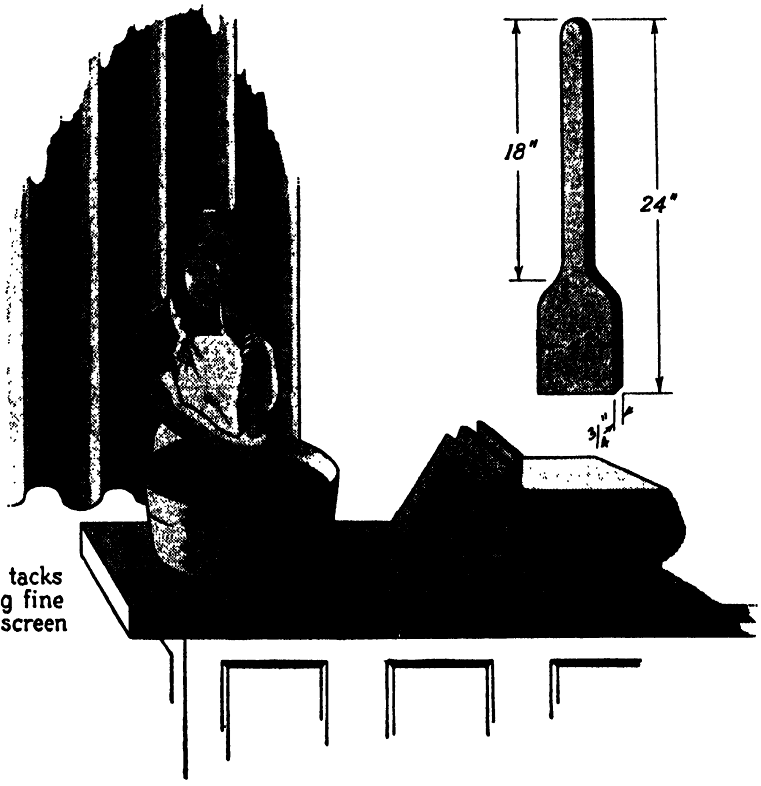
COMPLETED FRAMES FOR TWO MOLDS AND ONE DECKLE SHOWING MATCHING HOLES



DECKLE
SAME AS MOLD BUT WITHOUT SCREEN



MOLD



MAKING RAG-PAPER PULP

A large pail, wooden paddle, scissors, a small masher weighted with concrete, white cotton or linen rags, caustic soda or lye, litmus paper, chloride of lime or bleaching powder, and a food chopper will be needed to make the pulp.

Dust the rags in order to remove as much dirt as possible. This should be done out-of-doors or in a well-ventilated room. Then, remove all buttons, hooks, and other noncloth materials. Shred the rags very fine by tearing them in narrow strips, and cut the strips into small pieces about one inch long. Fill about one third of the pail with these small pieces of rags and add enough water to make the pail about two thirds full. Allow the rags to soak for a day.

Wash the rags by adding one-quarter pound of lye to the rag-and-water mixture and boil for three hours. Caustic soda is chemically the same as lye. Stir the mixture with the wooden paddle. Set away for a day so that the pieces of cloth will fall apart more readily. In the paper industry caustic soda is used in the quantity of 5 per cent to 8 per cent of the weight of rags treated. The mixture is boiled from three to seven hours and constantly stirred.

After being washed, the rags are broken with the concrete masher, then beaten and stirred with the wooden paddle. *Be careful that the mixture does not splash on the skin or the clothing as it is injurious to both.* During this breaking and beating process fresh water is continually added to and poured off the mixture. Be careful that it does not overflow and that small pieces of rags do not spill out. Wash the rags in this manner until they are free of the caustic soda. A test to determine this is to wet a piece of red litmus paper with the mixture. If the paper stays red, the caustic soda has been removed. If the paper turns blue, the mixture should be washed again. After all the soda is removed, mix the bleaching powder with water and add it to the rag pulp. Allow the pulp to stand for several hours and then thoroughly rinse out the bleaching powder using plenty of water. Drain most of the water from the rags and put them through a food chopper three times. Use the coarse cutter for the first time and a very fine cutter for the second and third times. Finally put the pulp into a pail and add water. Let the pulp soak until the next day.

MAKING PAPER FROM RAG PULP

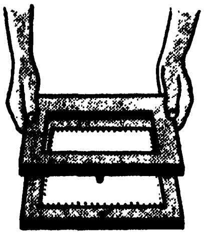
A paper form, prepared rag pulp, large dishpan, wooden spoon, two felt pads 12″ x 8″ x ½″, small drawing board, clothes wringer, electric iron, white cloth or sheeting, and two sticks ½″ x 24″ will be used in the final steps of making paper.

Pour the prepared pulp into a large dishpan and add enough water to make the pulp float. Place the deckle on top of the mold; this is the frame with the wire screen. Slide the assembled mold and deckle into the pulp. Level the form until the deckle is even with the top of the water. Now shake the mold from side to side and rotate it so as to get an even distribution of pulp on the wire screen. This shaking also causes the fibers to lie in all directions.

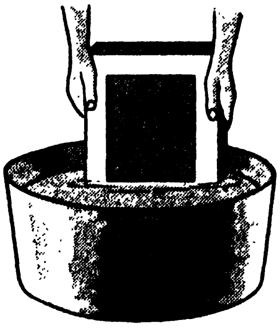
Lift the mold and deckle from the pan. Allow the water to drain through the screen and into the dishpan by putting the two flat sticks across the top of the pan and setting the form on these to drain for at least three minutes.

Remove the deckle and place a piece of felt carefully over the matted pulp. Turn felt and mold over onto a drawing board and then remove the mold. *This must be done with care or the wet felted paper will crack, causing a weakened sheet.* Place a second piece of felt over the felted paper. Put the felt-protected paper through a

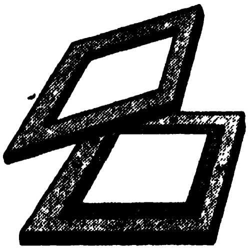
MAKING PAPER



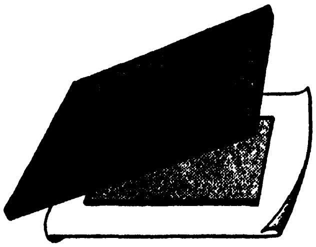
ASSEMBLING THE
MOLD AND DECKLE



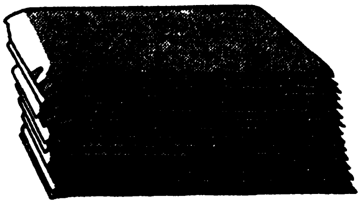
DIPPING ASSEMBLY
INTO PULP TUB



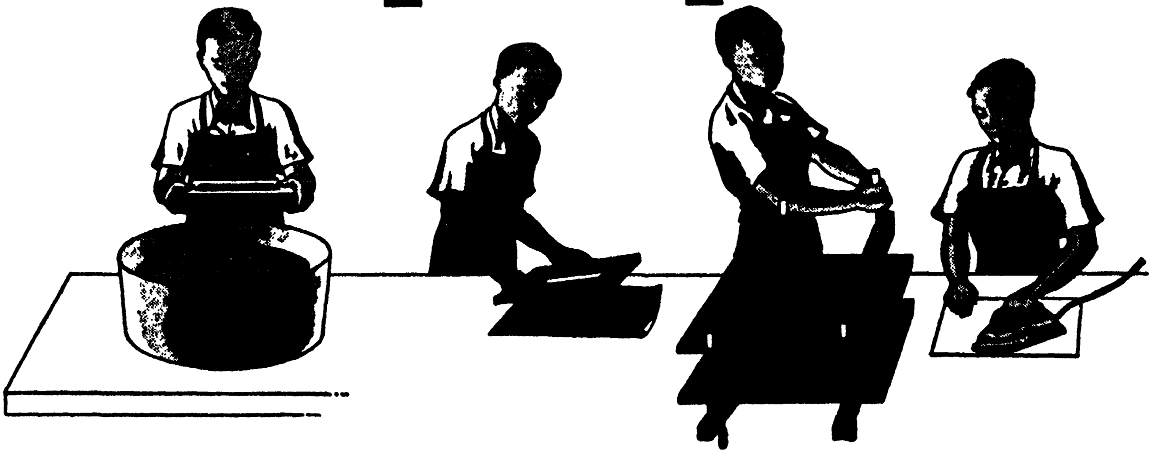
DECKLE REMOVED
SHOWING WAD OF
PULP ON MOLD



DEPOSITING PULP
ON PAD OF FLANNEL
OR FELT



STACK OF WET SHEETS
WITH PADS BETWEEN,
READY FOR PRESSING



clothes wringer three times. The rollers of the wringer should be adjusted with slight pressure for the first wringing and increased each time for the other two. Remove both felt pads from the sheet of paper and hang them in a warm place to dry.

The paper is now ready for drying. This is done by placing the sheet between two pieces of white cloth sheeting and ironing until the paper is dry and smooth. Do not have the iron too hot. Hang the sheet of paper on a line with paper clips for further drying. In drying the paper, the ironing may be omitted and the paper placed flat across two strings stretched across the room. This method requires a longer time for the paper to dry and gives a rough finish. When the paper is completely dry, it is ready for use.

SIZING PAPER

A rectangular pan about 8″ x 12″ x 1½″, a one-gallon pail, one-quart jar, gelatin powder, alum, cloth starch, a water-soluble dye, and a gas or electric plate will be used in sizing and coloring paper.

Paper is sized for the purpose of making it somewhat more waterproof and to prevent the spreading of ink. Sizing in the paper industry is done either by machine or by hand. In machine sizing, rosin is mixed with the paper pulp and the process is called *engine sizing*. The hand or tub sizing is done by dipping the paper into a sizing bath after it is made and dried.

Gelatin-Alum Sizing

Dissolve an ounce of gelatin powder in one-half gallon of warm water in the small pail. In the quart jar dissolve one-half ounce of alum, or one heaping teaspoon, in one-half pint of warm water. Add the alum solution slowly to the gelatin mixture. The alum increases the thickness of the gelatin; but, upon continual addition of alum this thickness lessens. When this happens, no more alum should be added as the sizing is ready for use.

Pour the gelatin-alum mixture into a shallow pan to the depth of one-half inch. Dip the dry sheet of paper into the solution, take it out immediately, and hang the paper up to dry. This process is called *tub sizing*. This gelatin-alum process may be used for sizing papers that are made commercially.

Starch Sizing

Starch sizing is done during the process of preparing paper pulp and is used chiefly for the hand-made papers. When the rag material has been completely broken down and washed, the starch is added. This type of sizing is cheaper and gives a finish that is not as glossy as that of gelatin-alum. Starch has the effect of deadening the color and should not be used for sizing when making colored papers. For sizing colored papers, use the gelatin-alum process.

Powder enough cloth starch to make a cupful. Put the starch into a quart jar and add enough warm water to fill the jar three quarters full. *Stir well.* Heat the pulp until steaming and add the well-stirred starch and water until the pulp is the thickness of thick cream. Cook the mixture for ten minutes and then proceed with making the paper.

COLORING PAPER

Paper is dyed for the purpose of making the sheet more pleasing to the eye and for decorative purposes. Cheap paper is sometimes colored to hide the poor grade of materials from which the pulp is made. Paper is dyed by adding water-soluble colors to the pulp. The intensity of the color depends upon the amount of dye added.

Mix enough water-soluble color, either powder or liquid dye, to a half pint of warm water to make a concentrated color solution. To the starch-free pulp slowly add this dye until the desired color is obtained. Stir well during the process.

COLLECTING PAPERS

People like to make collections and you should enjoy making a paper collection. Get several of your friends who are interested and see who can make the largest identified paper collection. Be sure you recognize each piece. A collection book neatly mounted and lettered is always best.

Each day we come in contact with or have use for different types of paper. There are many grades of paper each made with different materials and by a variety of processes. In order to use and purchase paper wisely, you should be able to determine the characteristics of different papers. With this purpose in mind the following experiments should be performed and a record kept of your results and findings.

Paper mills, wholesale paper companies, and many large printing companies have laboratories in which they test papers. In these laboratories there are expensive pieces of apparatus used to test for such qualities as ash, bursting strength, tensile strength, and stretch.

A small user of paper cannot afford laboratory equipment to make these tests; so he must resort to practical methods of testing. The methods of testing given here are possible without expensive apparatus and will show in a general way the color, finish, substance, texture, opacity or nonreflection of light, bulk, cleanliness, strength, and folding and wearing qualities of your papers. You should put the results of your tests along the right side of each piece of paper in your collection.

Testing for Color

To test for whiteness and permanency of color, use the different white papers from your collection and any others your teacher may give you. A sheet of paper is chosen the whiteness of which is taken as *standard.*

Place a number written with pencil on each sheet of white paper you are testing. Take the standard paper in one hand and a single piece of paper to be tested in the other. Now turn your back to a window and hold the two sheets of white paper so that the light is evenly distributed over both of them. Compare the whiteness of the piece being tested with the standard sheet. Record the results in your collection book by using one of the following terms to describe the paper: bluish-white, reddish-white, cream, or white.

To test the permanency of the color, place sheets of white and colored papers in the sunlight and cover half the surface of each with cardboard. The next day remove the cardboard and note the differences in color between the part that was covered and that left uncovered. What is the result?

Testing for Cleanliness

Cleanliness refers to the lack of defects in sheets of paper. To perform this test, you examine the pieces of paper in daylight or strong electric light. Have the light strike the surface of the sheet directly and examine both sides for such impurities as specks, grit, dirt, rosin spots, and raw-color spots. Now hold the paper so that the source of light is at the back and shining through the sheet. Check for the same impurities and also look for fiber lumps and pinholes. Record your results.

Testing Folding Strength

Where severe handling and much refolding is necessary the sheet must have good folding qualities. The majority of papers fold best *with the grain.* While some fold well in both directions, heavier papers and cardboards break or fold unevenly when folded *across the grain.*

To test a sheet for folding, fold the sheet both with and across the grain so that the folds are at right angles and cross each other at a point. Now fold the sheet in the opposite direction and in the same folds. Note the condition of the paper along the folds and at the point of meeting. If the sheet folds unevenly, breaks, or has a hole or rough weakened spot at this point, the folding qualities are considered poor.

Testing for Smoothness

The finish of the paper used in printing is, in most cases, the quality to be chiefly considered. It is upon the finish that the printing possibilities often depend. Take the different pieces of paper in your collection and move your fingers over the surface of each sheet. Note if the surface is very rough, slightly rough, smooth, or very smooth. Record the results using one of the above terms.

Testing the Texture

Hold each piece of paper level with the eye and observe the *fiber stand.* This is fiber that shows on the surface. Also note the amount of light that is reflected from the surface when the paper is in this position. The greater the reflection, the more shiny is the surface. Describe the amount of fiber stand and the condition of the surface as dull, glossy, or shiny.

To determine the texture of paper hold a single piece so that the light is back of the sheet. Notice how even and smooth the paper is. A *wildness,* or patchy, cloudy appearance, indicates an uneven formation and thickness of sheet. This is a poor grade of paper. The sheet may be so poor as to be useless for certain types of printing.

In testing coated papers tear the sheet both ways and note the amount of enamel which may be removed by rubbing the finger along the torn edge. If only a slight amount rubs off, the enamel is properly put on. If a large amount can be seen on the fingers, the coating is not thoroughly anchored to the body of the sheet.

Testing the Grain

As the fibers are felted into the sheet while being carried over the wire on the paper machine, most of them remain parallel with the edge of the sheet. This is the reason the grain runs the length of the paper when in a roll. But, when paper is cut into smaller sizes, the grain may run lengthwise in some sheets and crosswise in others.

To determine the direction of the grain moisten a small section of the sheet being tested along any edge. Press this section out between the finger and thumb. Note what happens to the edge as it dries. If the edge presents a wavy or curled effect it is across the grain. The edge is with the grain if it remains straight.

In some papers the direction of the grain can be found by tearing. Carefully tear the piece of paper tested in one direction and then in the opposite. Note the appearance of the fiber on the torn edge and the straightness with which the paper tears. The grain runs in the direction in which the fibers are torn cleanly and the tear is straighter.

INDUSTRIAL PAPERMAKING

What a contrast between modern methods of papermaking and those formerly used! Papermakers today talk in terms of hundreds of tons produced each day while in colonial times they talked about hundreds of pounds. Machinery has caused the tremendous increase in production. Also the fact that man is continually thinking of improvement has caused him to invent

Courtesy Howard Publishing Company

RIVER BARGES DELIVERING LOGS TO THE PULP MILL

quicker and better ways for the machines to operate. More materials are discovered from which paper can be made. Newer methods are thought out for testing paper. All of these make possible the great quantities of paper used today.

Most paper is made by cooking and steaming wood fibers until they have been softened. Our northern states used to furnish the greatest share of the trees for paper, but now Canada contributes the most. In past years the cutters of trees did not have to replace them. Now they are very scarce in this country, and so national laws have been passed requiring that young trees be planted when the old are cut down. Much rocky wasteland in southern United States has been replanted and is returning valuable wood for the new southern industry, papermaking.

The logs are cut in the forests and taken to the paper mill by boat or train or are floated down rivers. When they reach the paper mill, the logs are cut into four-foot lengths and have the bark taken off. Some of this bark is used for tanning hides in making leather. The logs are then taken to the *chipper*, a powerful machine that shreds the log into chips for pulp making.

The chips are cooked by steam in a tall cylinder called the *digester*. Acid is added to the steam and chips to help shred and

Courtesy Champion Paper Company

MAKING PAPER ON A FOURDRINIER MACHINE

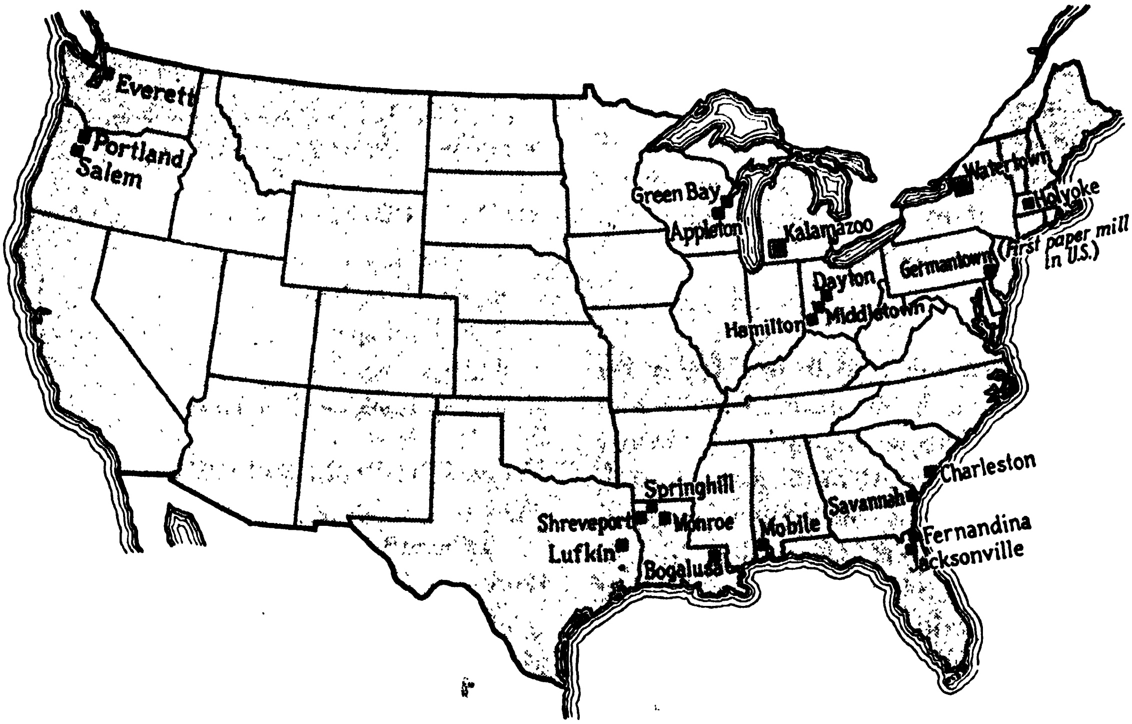
soften the wood fiber. The chips lose their shape and are a spongy mass of pulp that contains some gravel, dirt, and splinters. These impurities are separated by using water to float off the lighter fiber.

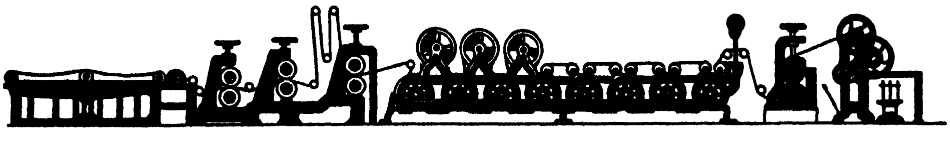
The pulp and water is then pumped to the *beater*, where the pulp is further shredded and softened. This beater is an oval-end tank about as high as a man's hips. While the beating is going on, things are being added to the pulp. Clay is put in to fill, or *load*, the paper. The clay dries between the fibers and makes the finished sheet so that you cannot see through it. This quality is called *opaqueness*. Starch is used to give a smooth surface and color is added if the paper is to be tinted. Alum is also used when color is wanted.

A stream of this water and wood pulp is directed into a machine to make the paper. This is known as a Fourdrinier machine and is named for the Frenchman who introduced it into England in 1799. It is an immense piece of machinery about 225 feet long and from 100 to 172 inches wide. The machine 172 inches wide produces a roll of paper 156 inches in width.

The mixture is 98 per cent water and 2 per cent fiber and is directed onto a copper-screen belt woven so fine that there are 5000 holes to the square inch. Here the fiber is matted and overlapped into place by a sidewise motion as the screen travels forward at a high speed. Much of the water drips through here and more is removed when the wide blotterlike sheet passes over a large brass roller where the water is sucked from the paper. It then travels through a series of rollers that press it together, dry, and then polish smooth the surface. The polishing rollers travel much faster than the paper and iron the screen marks off the bottom. Look closely at the back of a sheet of paper. On some the screen

LOCATION OF PAPER MILLS





A FOURDRINIER PAPER MACHINE

imprint shows if the light strikes it at the correct angle.

Many *grades*, or kinds, of paper are finished when they leave the machine. However, if a glossy paper is required, the rolls are sent to another machine to receive a coating of chemicals that forms a very smooth surface. This paper is called enameled paper and is used for very fine picture printing. See whether you can find such a sheet in some book. The sheet is generally printed and then pasted into place in books. Waste paper that is collected and sold is chopped up, soaked to loosen the fibers, and remade into box paper for shipping boxes. Rags as well as wood fibers are used for making paper. Rag paper is used for the better grades of writing paper and for all legal recording. It is known as bond paper and will last many years longer than that made from wood fiber.

SUMMARY

Hand-made paper is still used today for special jobs. It is interesting to make and requires only simple equipment. Paper comes in many strengths and finishes each designed to serve a particular purpose. When buying paper, the color, finish, strength, texture, cleanliness, and folding and wearing qualities should all be considered. Papermaking is one of the essential industries of our present civilization when the vast amount of paper that is used daily is considered. Most paper is made from wood pulp, but rag paper is better when strength and length of service are desired.

QUESTIONS

1. Why is some paper still made by hand?
2. Where was the first papermaking plant in America located?
3. What is a mold and deckle and how is each used?
4. How is paper dried after it is made?
5. Why size paper?
6. What can be used for sizing paper?
7. Why color paper?
8. What is done to the wood chips so as to turn them into pulp for paper?
9. How does enameled paper differ from newsprint?
10. What is the difference between paper made from rags and that from wood pulp?

TOPICS FOR DISCUSSION

1. Making Paper from Rags.
2. Preparing Rag Pulp.
3. Sizing Papers.
4. Paper Testing.
5. Papermaking from Trees.

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CHAPTER XV

PHOTOGRAPHY

There is much fun in taking pictures as a hobby. A permanent record of the events in your life can be made month by month and year by year with the camera. More and more people are packing a camera when they take a trip for either a few hours or longer. Later they get much pleasure in looking over the pictures taken. Certainly taking many pictures in and about the home forms a definite and worth-while record of family history.

Many people record the interesting events that occur on the trips which they take by carrying a moving-picture camera in place of a still camera. They may take their pictures, *shots* as they call them, either in black and white or can purchase special film and take them in colors.

Chemists have been working to produce new formulas so that the amateur will be able to secure finer pictures. Optical science has been at work improving the lenses and other attachments for cameras so that clearer and better pictures may be taken. Recent improvements get pictures where a few years ago they would have been failures. Photographs are now practical in natural color as well as in black and white.

There are many types of cameras and they range in price from a dollar or two to thousands of dollars. The quality of the lens, the special mechanisms, and the care with which they have been made all determine the price you pay for a camera. For a beginner perhaps the best type to purchase is one of the inexpensive box cameras. Learn how to take good pictures with it, and then purchase a better one equipped with a more accurate lens and shutter.

CAMERA CONSTRUCTION

The Diaphragm

You find on the front of a camera an opening through which the picture is taken. Behind this opening in most cameras is a group of flat thin steel leaves arranged to form a small round hole in the center. By pushing a little lever attached to the leaves the opening can be made larger or smaller. This mechanism is called the *diaphragm* and is used to regulate the amount of light that is admitted through the lens to make the picture. If the light is very bright, the diaphragm is made smaller to admit less light so that the film will not be overexposed. If the day is dull, the diaphragm is opened to admit more light.

The Lens

Behind the diaphragm we find a carefully ground glass *lens* through which the light rays pass to form the image on the film. The lens produces a sharp clear picture which is inverted on the film. At the back of the camera the film is held on spools so that it may be rolled from the full spool above to one below. The film passes down the back of the camera with the sensitive side toward the lens. After a picture has been exposed, the film is rolled forward bringing an unexposed strip into place.

The Shutter

Back of the diaphragm is located the *shutter*. It is made of thin sheets of steel on a pivot forming a small hole at the center to allow the light to enter the camera as the shutter swings past the lens opening. A trigger releases the shutter, and a spring makes this shutter move rapidly across the opening permitting light to enter the camera for a fraction of a second while the picture is being taken. Light reflected from the object passes through the diaphragm opening and the lens to the film as the shutter snaps open.

The Film

The film is coated with a light-sensitive chemical *emulsion*. This emulsion is a coating in which silver particles called *halides* are suspended or floating. These particles are very sensitive to light and are coated on the gelatin film in darkness by machine. The film when dry is rolled or packed in a manner to prevent light striking it before it is placed in the camera. For example, roll film is rolled in opaque lightproof paper so that it may be put in the camera without allowing any light to reach the emulsion before the *exposure* is made.

When an exposure is made, the light reflected from the various objects in the scene being photographed is momentarily admitted through the shutter and projected on the light-sensitive surface of the film. Light-colored objects reflect more light than dark; therefore the light reflections through the lens are in different strengths or intensities. Light striking the sensitive film causes a chemical reaction. The different strengths of the light cause more chemical action in some places than in others. In this way an accurate reproduction of the scene or object is produced in the emulsion of the film, but it is not visible until developed. This invisible image that exists on the film is called the *latent* image.

The production of a visible image on the film is also essentially a chemical action. There is a difference of opinion as to what actually takes place but it is certain that when the silver compounds—silver bromide, chloride, and iodide—are exposed to light they quickly undergo a chemical change that tends to reduce them to metallic silver. The light strikes the film in different intensities and where there is the greatest intensity the reduction toward metallic silver is the greatest. The *developing bath* continues this reduction toward free silver metal in the emulsion. Chemicals that have the ability to free silver from its salts are used. Such chemicals are known as *reducing agents* and act only on the portions of the silver that have been exposed, leaving the unexposed portion unaffected. The *stop bath* is a chemical agent that arrests all further action of the development. The *fixing bath* is a chemical bath for the purpose of removing all the silver compounds that were unaffected by exposure and development. Removing these prevents any further reduction toward silver metal. The chemical best suited to this removal has been found to be sodium hyposulphite, called "hypo."

Box-Camera Experiments

Remove the back of a box camera and hold it toward the light. Place it near your eyes, open side toward you, and set the release indicator at "I." The "I" setting means *instantaneous.* When the setting is on "I," the spring tension is such that the shutter remains open for about one twenty-fifth of a second. This length of exposure has been found satisfactory for most snapshots. Snap the trigger. Notice the short interval the shutter stays open. If you have a camera with different shutter speeds, try these speeds.

Move the release indicator to "T," or time. Snap the trigger again and see what happens. You will notice that light continues to enter the camera until the lever is pressed a second time. Some cameras are equipped with a "B" stop in addition to the "T." The "B" stop is called *bulb.* The difference between these two stops is that when the setting is on "T" the shutter release must be pressed once to open the shutter and once again to close it. When the setting is on "B," the shutter is opened and closed by pushing the lever down to open it and releasing the lever to close it. Because any slight movement of the camera may spoil a picture the "B" setting is preferable for making time exposures since it involves less manipulation of the shutter release. The "T" and "B" settings are used to take pictures indoors or on dark days when a long exposure is needed. The camera must be placed on a *steady surface* such as a table, box, or post when using either opening.

With the indicator at "T," open the shutter and move the diaphragm as far open and closed as it will go. Notice the changes of sizes as you do this and the amount of light admitted or shut out. Some of the cheapest box cameras do not have an adjustable diaphragm.

Types of Film

Films are made in four forms: rolls, packs, cut film, and glass plates. The first three have the emulsion placed on sheets of celluloid and are the ones common to the amateur. Glass plates are usually used by the professional photographer for studio work. Cut film is used by news photographers. Because roll-film cameras are most common, roll-type film, a continuous emulsion covered strip usually providing space for six or eight pictures, is used most often. The pack films are a set of cut celluloid oblongs that is inserted into the camera in place of the spooled roll.

The advantage of cut film and film pack over the roll films is that single exposures on the film may be removed immediately for development. Roll film would involve an unnecessary waste of either time or film since it cannot be removed from the camera until all the film has been exposed unless the photographer wishes to waste the unused portion.

On the outside of roll film is found a strip of black surfaced paper. It is much longer than the film itself and is used to protect the film from light while placing it in and taking it out of the camera. Keep this rolled tightly to the spool at all times so light will not leak in at the ends and spoil the pictures. Never load or unload a camera in bright sunlight. After the last exposure has been made, turn the film winder until the paper backing is no longer visible through the little red window on the back of the camera. This indicates that the film is completely rewound on the take-up spool and may be safely removed. Seal the end of the paper to the roll with the gummed paper provided. Transfer the empty spool to the take-up position to receive the end of the paper for the new film and then place a new roll in the camera.

TAKING THE PICTURE

What pictures shall I take? That is a difficult question to answer because each person sees beauty differently or has unique ideas of scenes, objects, or formations. What one person might photograph and produce as an interesting picture others might pass by without noticing. Keep your eyes open for both usual and unusual subjects to photograph. Beginners will do well to give their attention to stationary objects, such as scenes and buildings. Do not attempt at first to take pictures of objects closer than eight to ten feet from the camera.

In taking pictures of living things, watch until a natural and good position is to be had and then shoot quickly. One man who is an amateur camera fan told me recently that he waited on Sunday for more than five hours to take a picture of a raccoon. He knew the raccoon frequented this particular spot. At last he was rewarded. He secured his picture and sold the print for $25 to a well-known magazine. Many unusual prints are sold by amateurs to newspapers, business firms, and publishers.

When photographing a building, do not tilt the camera up to get the whole building in the picture. A lifted camera will make the building appear as if it were leaning away from you. If the camera is tilted sideways, the building will appear as if it were falling to the right or left. Remember that the fingers must be kept away from the opening in the front of the camera and that the lens must be kept clean so that the pictures do not appear foggy. Some people jerk the release and move the camera, which results in a blurred picture. Use an even steady pressure so that the camera is still while the shutter admits the light. Often a beginner forgets to turn the key which rolls the exposed part of film away after a picture has been taken. The result is a second picture taken on top of the first and spoiling both. Make it a habit to roll the film away immediately after an exposure so that your camera is ready for a quick shot if necessary.

Experience alone can tell you how much light should enter the camera for good results. On dark days set the indicator to "T," press the release trigger to open the shutter, hold the camera *very still* for a few seconds, and press the trigger again to close the shutter. The darker the day, the longer the shutter should remain open. For a few cents one can purchase an exposure chart suggesting how long to keep the shutter open. On an ordinary day if you are operating a box camera set it at "I" and snap the trigger *only once* for a picture. Never take a picture with the sun shining directly in the lens or a blur will result.

MAKING A CAMERA

Do you know that any careful worker can make his own camera and take pictures with it? These cameras have been made in camps, at home, and in the school. No doubt you will want to experiment with making one.

The camera consists of a cardboard box with a very small hole in the front and a piece of film fastened at the back. It is important when making this camera that you measure and cut quite exactly if you expect good results.

The following materials are needed: a strip of cardboard 5″ x 21″, ⅛″ x ⅛″ softwood strips, thin metal or foil, bookbinder's cloth or Scotch tape, cardboard cylinder and cap, glue, paste, tube of ambroid, black paint, piece of film, ¾″ soft wood, and a cork.

The tools necessary are a razor blade with reinforced back, sharp pocketknife, heavy needle or pin, shears, straightedge, paste brush, brace, ¾″ wood bit, and a try square.

Secure the piece of cardboard 5″ x 21″ having one surface of dull black. Black matboard is the trade name for this material. Ordinary cardboard blackened on one side with black tempera paint may be used. It should be between $\frac{1}{16}''$ and $\frac{1}{8}''$ thick and is used to construct the box part. Place a piece of wood below the cardboard so the table top will not be spoiled. Cut the board $4\frac{3}{4}''$ wide and 21″ long using a very sharp knife and a straightedge. With the try square trim one end so that it will be square. The strip of cardboard will be used for the top, *two* bottoms, two sides, and two ends of the camera. Make the two sides, top, and double bottom all in one piece as shown in step 1. Measure from the squared end toward the other end, marking a pencil line with the aid of a try square on the opposite surface from the black side as is shown. Lightly mark each rectangle for its position.

With a sharp knife and try square *score*, or cut part way through, the cardboard on the pencil lines. This helps to bend the board along the straight line. Bend each section to a right angle. Have the scored line to the outside and the black surface inside. Cut the back and front completely through and separate them.

On the rectangle marked *top*, cut out a narrow strip $\frac{1}{16}''$ to $\frac{1}{8}''$ wide. This opening which forms a slot at the back of the camera through which the film is placed is marked *A* in step 2.

Two strips of wood $\frac{1}{8}''$ x $\frac{1}{8}''$ x 3″ shown in step 3 need to be glued to the inside of each side at the back. This keeps the film from falling forward when it is placed in the camera. These strips can be made of cigar-box wood or thin soft wood from cheeseboxes. Notice how the strips slant. Attach the strips with either hot or cold glue and press them to the cardboard with weights for several hours.

Step 4 shows the cardboard folded and ready to be glued into box form. The second or longer side is on the left in the drawing. Use hot or cold glue when fastening and press together using two pieces of clean smooth wood. Pressure for several hours may be had by using clamps, screws, or nails. The use of wood and screws is shown in step 4*A*.

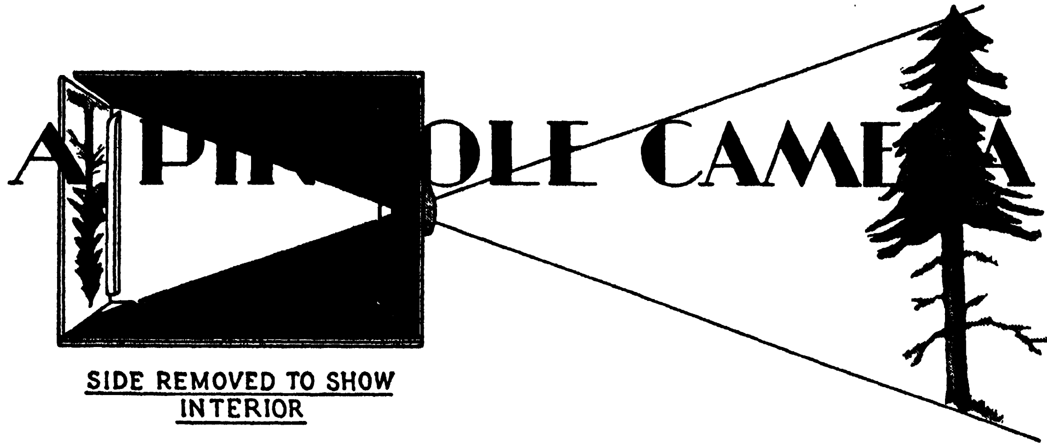
While the glue is drying, work on the other pieces. At the top of the back, cut a semicircular depression as shown in step 5. Make a paper template as shown in 5*A* and trace the shape on the cardboard.

Mark the front piece as shown in step 6 and cut a $\frac{1}{2}''$ opening with either a hollow metal punch or a sharp knife. This opening allows the light to enter the camera. A punch makes a better job. If using it, place the cardboard on either the *end* grain of a hard-wood block or a lead block. Strike one sharp blow on the end of the punch with a hammer. Over this $\frac{1}{2}''$ opening a piece of thin metal that has a very tiny hole is cemented. It takes the place of the lens in an ordinary camera.

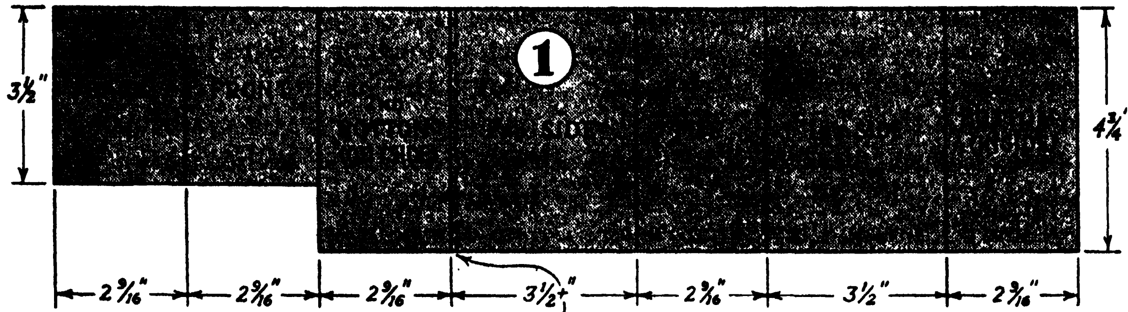
Secure a piece of thin metal foil such as is used around some kinds of gum or flowerpots or flowers. Straighten the foil with the flat side of a pencil and cut a piece about $\frac{3}{4}''$ square. Place this foil on a piece of soft wood and drill or burn a very small hole through it using the point of a pin or needle. To drill, revolve the pin or needle several times between the thumb and first finger pressing down slightly. Heat the needle to burn the hole. Drilling is illustrated in step 6*B* on page 137. Fasten this metal with the hole in it to the front cardboard. Be sure to get the hole in the exact center of the rectangle. Either rubber or ambroid cement may be used.

A shutter tube is needed to keep the light out of the camera except when a picture is being taken. This can be either a piece of cardboard tube with a cardboard cap or a

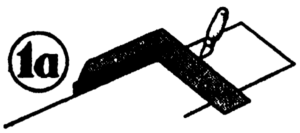
A PINHOLE CAMERA



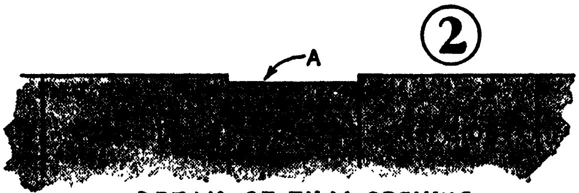
SIDE REMOVED TO SHOW INTERIOR



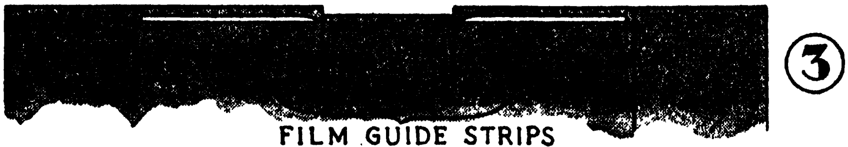
Thickness of cardboard added to second side



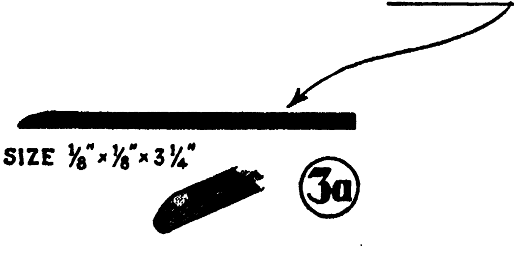
SCORE WITH KNIFE TO AID BENDING



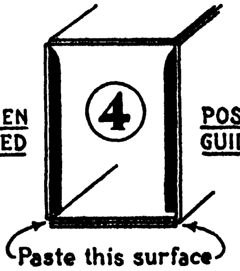
DETAIL OF FILM OPENING



FILM GUIDE STRIPS



DETAIL OF FILM GUIDE SHOWING ROUNDED END

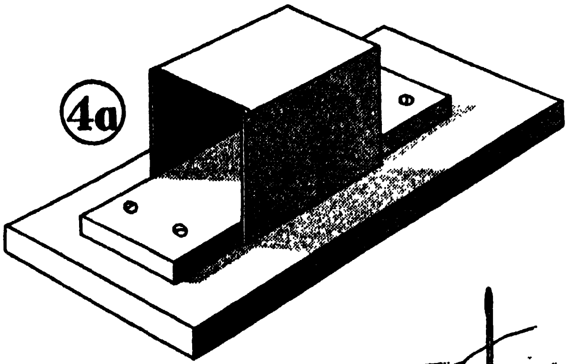


VIEW WHEN ASSEMBLED

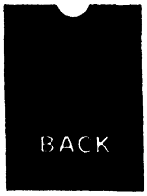
POSITION OF GUIDE STRIPS

Paste this surface

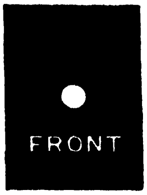
4a



CLAMPING DEVICE USING 4 WOOD SCREWS

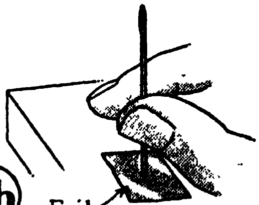


5



6

6b

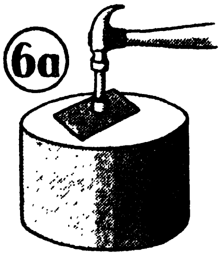


TWIST THE NEEDLE

5a

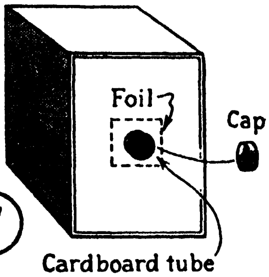
TEMPLATE FOR MARKING BACK

6a



PUNCHING HOLE WITH SHEET-METAL PUNCH

TWO WAYS OF SHIELDING THE APERTURE



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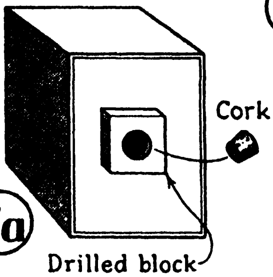
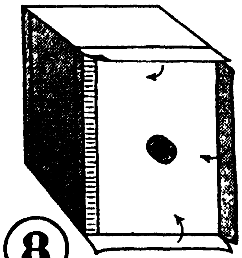


7a

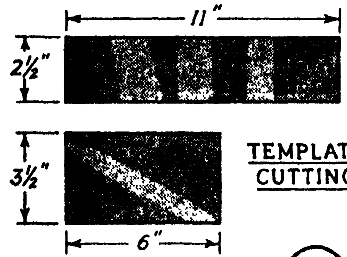
7b

DRILL HOLE BEFORE CUTTING BLOCK



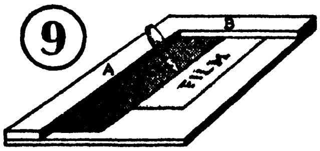
8

CUTTING THE FILM

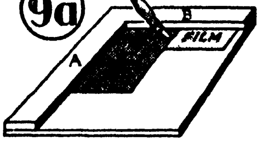


TEMPLATES FOR CUTTING FILM

9



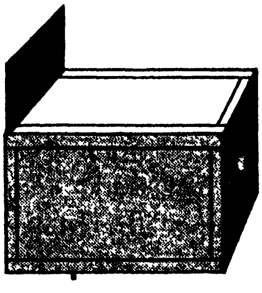
9a

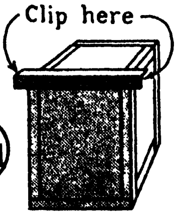


CUT THE FILM IN TOTAL DARKNESS
BE CAREFUL · DO NOT SCRATCH FILM

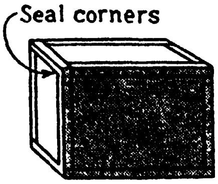
LOADING THE CAMERA

10





10a



10b

block of ⅞" wood with a ¾" hole bored to receive a cork.

This tube for the front is cut 1" long and is cemented to the front of the camera with ambroid cement. Step 7 shows the foil and tube cemented in place. If a block of ⅞" wood is used, first bore a ¾" diameter hole in a larger piece of wood than desired and then cut the block to the size wanted. The auger bit would split a small piece of wood. Cement or glue the wood in place and use the cork to keep light out. The inside of the shutter tube should be painted a dull black.

Fasten the front of the camera in place by using 1" black gum tape. Do not use electrician's friction tape. Cut a length of tape that will go completely around the front of the camera and lap at least 1". Paste it on the camera so ½" extends. See step 8.

Slit the corners and bend the tape outward. Drop the front board in place, moisten the tape flaps, and press them in place on the front. Now paste the back in place. The tape does not go across the top along the back edge or the films could not be inserted. Cover all edges with tape as shown in step 10.

The camera is made for 2½" x 3½" film. It will be most economical to purchase 5" x 7" cut films and cut them one at a time into four pieces 2½" x 3½".

It will help very much if you construct a film-cutting jig of wood and metal. Such a device is shown in step 9. Cut the film with a reinforced razor blade and, of course, do all cutting and loading of the camera in a darkroom, using only regular darkroom light. *Use only* regular film in this camera.

To make the jig, fasten two strips of wood about ¼" x 1" on a wooden base about 7" x 9" so that a right angle is formed where they meet. Lay the long edge of the film against strip *A* and cover it with a sheet of tin 2½" wide. Make the cut with the razor blade. This forms two pieces 2½" x 7" long. Cut each 2½" x 7" piece again into two pieces using a piece of tin 3½" wide as shown in 9*A*. This method assures good rectangular films of the correct size *if* you keep both film and tin against *A* and *B*.

Load the camera in the darkroom by dropping the piece of film through the slit at the top of the box, emulsion side toward the front of the camera. Seal the film in place with black tape so no light can enter. See steps 10 and 10*A*. Be sure the front opening, *aperture* a photographer calls it, is closed with a cork or cap before this is done.

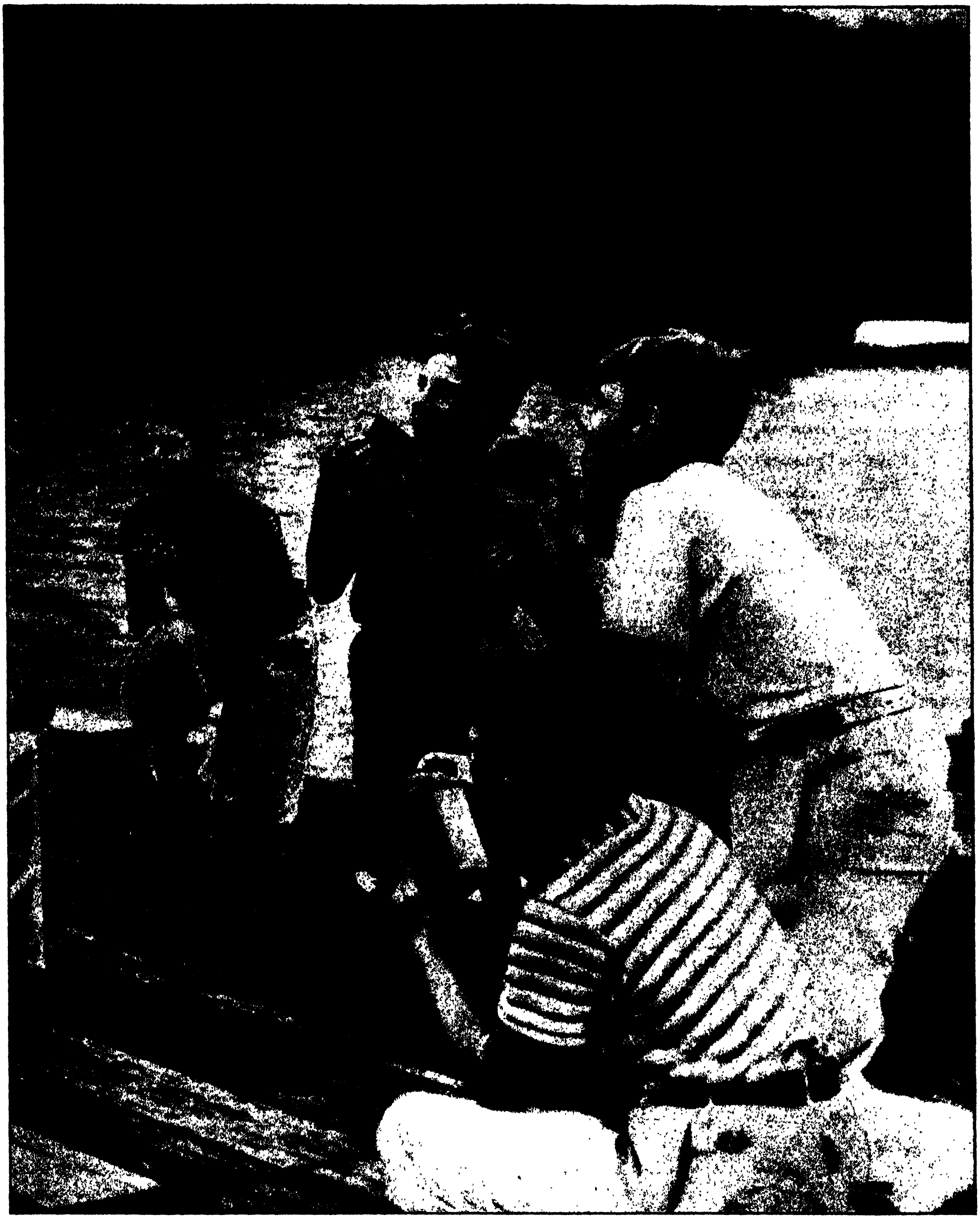
To take a picture, expose the film from fifteen seconds to three minutes depending upon the light. You must rest the camera on some firm surface so that it will not move. Open the camera by removing the aperture cap and replacing it again *without moving the camera.* Best results with this camera will be had in full sunlight. Some experimentation is necessary to learn the amount of time the light should be allowed to enter the device. After experimenting, mark this information on the aperture cap.

If the outlines of the finished picture are not as you wish, remember that you never get as sharp an outline with a pinhole camera as with one equipped with a glass lens

Take the film out in a darkroom by removing the black tape that sealed in the film. Develop the exposed film by following the directions given in the next chapter.

SUMMARY

Taking pictures is a definite and worthwhile means of recording family history as well as a most enjoyable hobby. These records may be either snapshots or moving pictures and can be in color or black and white. The lens and other mechanisms of a camera are what determine its cost. The



THE PINHOLE CAMERA CLUB

taking of pictures is a mechanical and chemical process. Upon releasing the shutter to admit light through the lens to the film, a chemical action takes place in the emulsion to form the latent image which must later be chemically developed and fixed. The choice of subjects is a matter of personal preference. The construction and use of a pinhole camera gives excellent experience toward a definite understanding of the principles of photography.

QUESTIONS

1. Why are some small cameras more expensive than some larger ones?
2. What is the diaphragm of a camera and how does it work?
3. What is the lens of a camera, what is it made of, and how does it function?
4. What is the shutter of a camera and why is it used?
5. Why do photographers use cut film instead of rolls of film?
6. Why is it not advisable to load a camera out-of-doors?
7. What are four things that might spoil a "shot"?
8. What is the aperture of a camera?
9. Are pictures taken with a pinhole camera as sharp and clear as when a glass lens is used?

TOPICS FOR DISCUSSION

1. Why I Take Pictures.
2. Operating My Camera.
3. Placing Films in My Camera.
4. Making a Pinhole Camera.

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NEBLETTE, C. B., and others.—*Elementary Photography,* Second Revised Edition. New York: The Macmillan Company, 1941.

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CHAPTER XVI

DEVELOPING AND PRINTING

A *darkroom* is absolutely necessary for developing and printing. By a darkroom is meant one that will not admit a single ray of white light to spoil the exposed film. This darkroom can be a closet, washroom, kitchen, or basement. You might construct a darkroom of your own using 1″ x 2″ strips for the frame and covering it with sheets of wallboard. The room ought to be about 6 feet by 8 feet and will serve better if it can contain a sink and running water. Special black paint that dries without gloss, to paint the inside, can be purchased. A table about 3 feet by 5 feet or a shelf along the wall is needed. Shelves and drawers arranged about the room will be handy for the storage of material. Some sort of ventilation should be provided without letting in light. Two electric lights are necessary, one a regular 40 or 60 watt frosted white bulb and the other a red safety light that can be purchased from any photographic supply dealer. For some types of film no light at all can be allowed in the room.

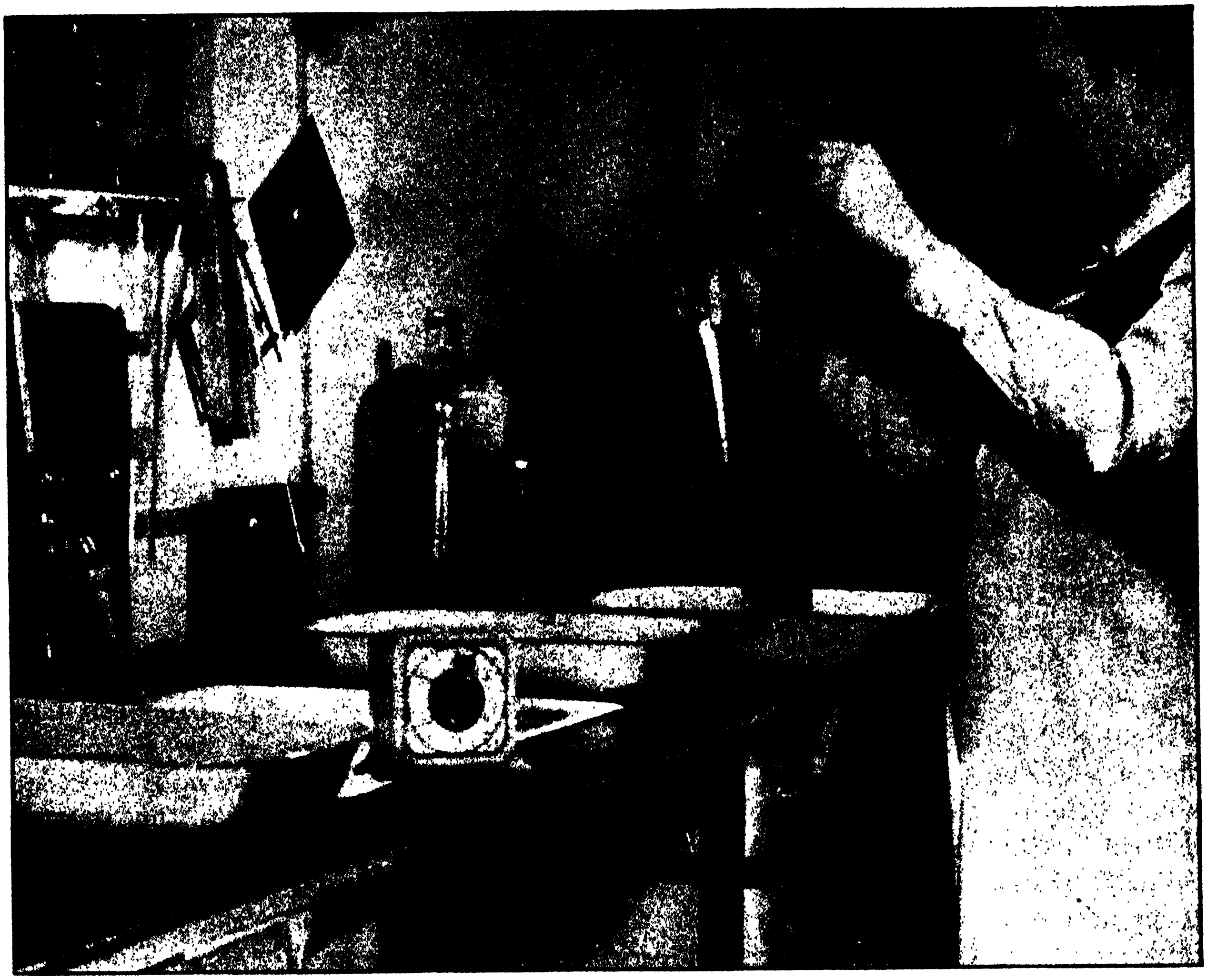
DEVELOPING THE FILM

Two methods of developing are possible: tray, which is the hand process, and tank developing. The tray method is simple and possibly more interesting; so you may wish to use it.

You need a small amount of equipment for this work; some of it can be made while the rest must be purchased. Trays should be 5″ x 7″ and about 2″ deep. One 8-ounce measure is needed; it can be a water glass or a half-pint milk bottle. A stirring rod of hard rubber can be purchased. If one is careful, a glass lemonade stirrer can take its place. You will need one Fahrenheit thermometer with the reading scale inside the glass. Stores sell these in the tropical-fish section. Several paper clips or wooden spring clothespins are used to hang films when drying. A piece of chamois or a soft sponge should be at hand. It is well to have several towels or an old cloth for wiping the hands.

Chemicals are necessary for developing. They may be purchased already mixed in the correct proportions in small tubes and boxes. Each chemical can be purchased separately and you then prepare your own mixtures. However, it is usually more economical for the amateur to purchase these ready mixed. Buy a few tubes of M.Q. developing powder and a package of hypo.

Place four trays on a table side by side. In the first one use clear water between 65° and 70° F. *It is important to have the water the same temperature in each of the trays.* In the second tray dissolve the developing powder as directed on the container. In the third tray you have water



DEVELOPING FILM BY THE TRAY METHOD

again 65° to 70° F., to be used for rinsing, or you may have a chemical solution known as *short stop and hardener*. See the formula for short stop and hardener rinse on page 149. In the fourth tray dissolve the fixing powders as directed on the package. Lay out two clips for each film to be developed; then turn off the white light and be sure the red is at least 3 or 4 feet from your trays.

Unfasten the protecting paper from a roll of exposed film and separate the film from the paper. Be careful not to get fingerprints on the surface of the film. Fasten a clip to each end of the film and pass it up and down a few times in a U shape through the first pan which contains clear water. Have the emulsion side of the film away from the bottom of the pan. This side is the inside of the roll when it comes from the camera and has a dull surface. If the emulsion side is down the film may become scratched and spoiled. The water softens the film and removes air bubbles that might cause uneven developing.

Now pass the film in the same manner through the developing solution. Always follow the manufacturer's directions for time and temperature carefully. At 65° F. the average tray developing time for film is about five minutes. You will be able to observe the development of the image as the reducing process continues. Experience will tell you how strong your image should appear to produce a good negative. However, relying on time and temperature will usually give good results.

Rinse the strip of film a few times in the third tray. If you add short stop and hardener chemicals all action will stop immediately.

After rinsing, work the film up and down in the fourth tray, containing the hypo or fixer, for twice the length of time required to clear the negative of its milky appearance. This will make the image permanent.

All chemicals need to be washed off the film after fixing. This can be done in two ways. The best method is to place the finished film in a dish and allow water to slowly run into the dish and overflow into a sink for 30 minutes. The other is to place the film in a large pan of water. Carefully agitate the film in this bath for a few minutes and then change the entire water. Repeat this operation at least ten times and then wipe off most of the water with a damp chamois or sponge and hang the film on a line to dry. Use both clips as the bottom one prevents the film from curling. The film should be out of drafts so it will dry evenly.

Making a Printing Box

The same darkroom, red light, and other equipment used in developing the film are used for printing the pictures. You will need a printing box in addition to this equipment. It can be purchased, or it can be made as follows:

Cut the two sides of ¾″ pine 8″ x 9¼″. The two ends can be of ⅜″ plywood. They should be 8″ x 8″. Nail the four pieces together with the thin wood against the ends of the thicker. Make a bottom board so that it extends 1″ on all sides and nail it in place.

Inside the box nail some thin strips of wood about 1″ wide as far below the top edge as the thickness of a piece of glass. These strips are to hold the glass which will be put in place later.

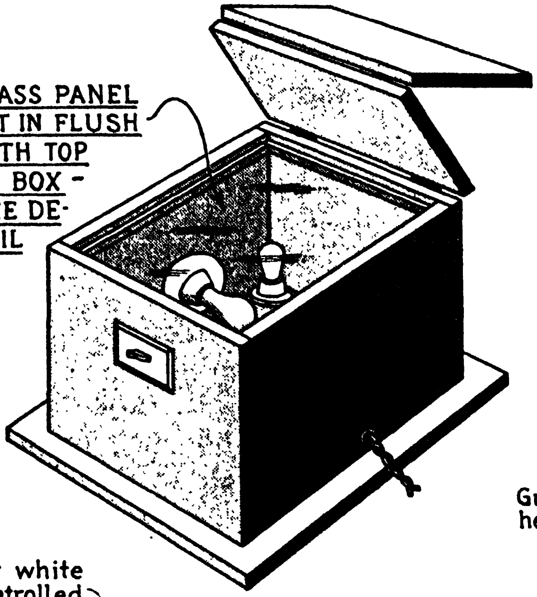
Wire the box with two porcelain sockets, one screwed on the side about 2″ from the bottom and at an equal distance from each end, the other on the bottom near one corner. The one on the side takes a 60 watt frosted bulb and is used for the printing. The one on the bottom is used for a small red bulb. On one side of the box install a toggle switch and connect it so that it will control the white light. This allows you to snap the white light on and off for printing. Wire the bottom socket so that the red light will burn continually when the printer is in use. Study the diagram on page 144.

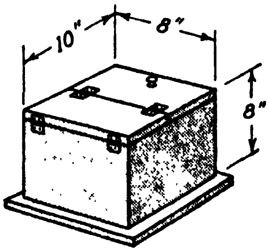
Paint the inside of the box with three coats of white or aluminum paint allowing each coat to dry twenty-four hours. Now cut a piece of glass to fit the opening in the top of the box and seal it in place with Scotch tape. Glue pieces of an old felt hat on the bottom at the corners to protect the table top.

A two-piece top, hinged in the center and at the back as shown on page 144, is placed above the printing paper. Cut the two pieces for the top of ½″ wood 5″ x 8″. Line the inside of these cover boards by gluing some flannel or felt cloth to the inner surfaces. Trim the edges of the cloth even with the wood using a razor blade. Fasten the two boards together with two 1¼″ tight-pin brass hinges and fasten the back cover board to the back of the box using the same-size hinges. The hinges in this case are screwed to the back edge of the cover. Screw a handle or knob to the front cover board. Stain and varnish the outside of the box or give it three coats of paint.

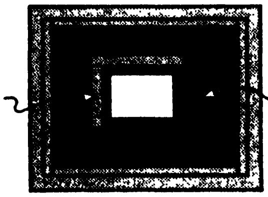
CONTACT PRINTER

FOR THE DARKROOM

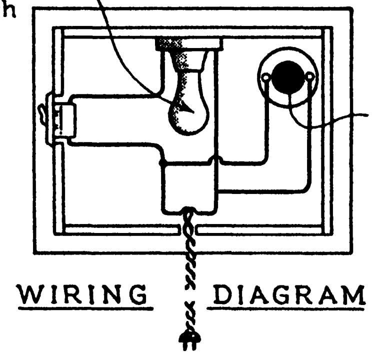




BACK VIEW SHOWING HINGE ARRANGEMENT



TOP REMOVED TO SHOW MASK AND GUIDE STRIP

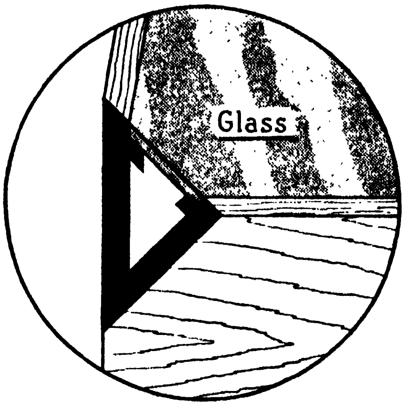

60-watt white bulb controlled by switch
5-watt red bulb burns continuously when cord is connected

WIRING DIAGRAM

1. FOR NEGATIVES SHOWING GREAT DIFFERENCE BETWEEN LIGHT AND DARK (CONTRASTY) USE SOFT PAPER

2. FOR MEDIUM NEGATIVES USE MEDIUM HARD PAPER

3. FOR NEGATIVES SHOWING LITTLE DIFFERENCE BETWEEN LIGHT AND DARK (FLAT) USE HARD PAPER



CORNER CUT AWAY TO SHOW METHOD OF SETTING GLASS

To prepare the box for printing, make a mask so that a white border will appear around the picture. Secure a sheet of black paper and cut out a rectangle with a razor blade and ruler in the center of the paper about ⅛″ smaller than the width and length of your film size. Swing both hinged cover boards off the top and fasten this mask with Scotch tape on the top of the glass so that no light escapes around the edges.

Scotch tape can be used as guides so that the borders of the printed paper are even. Place the tape the distance from the opening that you wish the white border of the print to be. When placing the printing paper in the device, have the edges just touch these guides. See page 144 showing these in place.

Contact Printing

You will need three 5″ x 7″ enameled trays, a measuring graduate, stirring rod, red light, towel, hypo, M.Q. developer, shears, printing paper, thermometer, and water. Have a gallon jug of water standing on the shelf at all times so that it will be at room temperature when wanted.

Arrange your printing box on a table having the red light several feet away. To the right of the box place three trays. In the first dissolve a tube of M.Q. developer according to the directions on the package using the room-temperature water (65° F.) from the jug. In the second tray have clear water for rinsing, or you may use a short stop rinse instead of water. Between the first and second trays place a towel for the hands. Dissolve the hypo or fixing salts in the third tray. Test all solutions with the thermometer for 65° F. as the correct temperature is important for good results.

Take your negative and place it in the printing box emulsion side *up* and cover it with the printing paper which should have the chemical or sensitized side *down.* Printing paper has a tendency to curl and the chemical is on the *convex* or hollow surface. Snap the white light in the box on for about three to six seconds and then snap it off. The time depends upon the density of the negative. A dark, or *dense,* film takes more light while a *thin,* or light, one takes less. Only practice and experience will teach you how much time to allow for the printing light.

There are many grades and types of printing paper. Sensitive papers are made for dense negatives. Harder or less-sensitive papers are for thin negatives, and there are several grades between these so that the best possible print may be obtained from the negative. Some papers have a smooth glossy surface while others have what is known as a mat, or dull, surface. Most people prefer a glossy print. It is advisable to have at least three grades of paper when printing, one package for dense negatives, the second for thin, and the third for medium negatives.

Take the exposed paper, handling it by the edges or corner, and quickly slide it under the developing solution moving it back and forth at the same time. Watch for the picture to appear, which it should do in a few seconds. When the print has reached a pleasing density, quickly transfer it to the clean water sliding it back and forth a few times to rinse it. Then transfer the paper to the fixing bath. Allow it to remain in this last solution about fifteen minutes, stirring or shifting it occasionally. If many prints are to be made, it is best to use a short stop rinse and allow the print to remain in it for about five seconds. Do not try to save this solution as it loses strength during use.

The print is now ready to be washed. This is best done in running water. Place the prints in a jar or large pan, fasten a hose to the faucet with the other end in a milk bottle or some such container so that

FIXING A PRINT IN HYPO

a direct stream of water will not strike the prints. Allow a very slow stream to flow through the container for at least forty minutes. Keep the prints floating; do not allow them to pack solid. If running water is not to be had, place the prints in fresh water in a large pan or jar and stir them with care. Allow them to stand for five minutes and change the water. Repeat this process at least twelve times.

It is advisable to print all the pictures you wish and then dry them. Stack the wet prints in a pile and press as much water from them as possible. Separate and lay the prints to dry on a white cloth surface, face, or picture side, down. Cheesecloth makes a good surface. It can be stretched tightly on a frame about two feet long by six inches wide. Do not lay the prints on paper or they will stick to it. After drying, trim the pictures to correct size and mount them in an album.

Using Ferrotype Plates

The amateur photographer will no doubt wish to make some of his prints with the commercial high-gloss finish. This is accomplished by using glossy paper and ferrotype plates. The ferrotype plates may be purchased in various sizes and at prices ranging from thirty-five cents to seventy-five cents each. The ferrotype plates are glossy black baked-enamel metal sheets. They are prepared for use by waxing the surface on which the prints are to be dried. Prepared waxes are available or ordinary automobile wax may be used. Apply a little wax to the plate with a damp rag just as you would to polish an automobile. Use a clean soft rag and rub the plate to a clear bright gloss.

The prints made on glossy paper after being fixed and thoroughly washed are removed from the wash water and placed face down on the ferrotype plate. Place as many prints on the plate as may be conveniently spaced so that they do not overlap. The excess water is removed with a rubber squeegee. The prints are then covered with a large clean blotter and rolled flat and smooth using a rubber print roller. Remove the blotter and set the ferrotype plate aside so the prints can dry. When dry, the prints will fall off the plate of their own accord. Never try to pull prints from the ferrotype plate before they are dry. Do not try to dry prints in a hurry by heating the plates. Too much heat ruins both plates and pictures.

Always store the ferrotype plates in a dry place and keep them clean. It is not necessary to wax the plates often as long as they are clean. It is best to wash the plates thoroughly with soap and water after they have been used four or five times, then rinse them thoroughly, and rewax them.

High-gloss prints are the type used by newspapers and magazines for reproduction because they give a clearer plate and a better finished picture. So the use of ferrotype plates should be understood and practiced by the amateur who wishes to produce pictures that might be salable for news or advertising purposes.

Formulas and Tank Development

Numerous formulas are available for amateur use for films and plates. Others are essentially for printing and projection papers. There are some developers that are satisfactory for films, plates, and paper where fine-grain development of the films is not of importance. In the development of miniature films where fine grain is essential, separate developers should be used for film and paper. It is important that each of the chemicals given in a formula be carefully weighed on an accurate scale. Failure to exercise accuracy in compounding photographic chemicals will result in either unsatisfactory products or complete failure.

A good formula for developing Panchromatic and Panatomic films and plates to give low contrast and good shadow detail is Eastman's D-76. All weights are avoirdupois.

Water, about 125° F.	96	ounces
Elon	116	grains
Sodium sulphite, desiccated	13½	ounces
Hydroquinone	290	grains
Borax, granular	116	grains

Dissolve the chemicals in the order given. Add enough cold water to make one gallon and use without dilution. For *tank* use develop about twenty minutes at 65° F. For *tray* use develop for about fifteen to sixteen minutes at 65° F. *The above formula is intended for films and plates,* not papers.

A good formula for films, plates, and paper is Eastman's D-72.

Water, about 125° F.	16	ounces
Elon	45	grains
Sodium sulphite, desiccated	1½	ounces
Hydroquinone	175	grains
Sodium carbonate, desiccated	2¼	ounces
Potassium bromide	27	grains

Dissolve the chemicals in the order given and add water to make 32 ounces. The 32 and hardener for films and plates is given here.

Water, about 125° F.	80 ounces
Sodium thiosulphate, hypo	2 pounds
Sodium sulphite, desiccated	2 ounces
Acetic acid, 28 per cent pure	6 fluid ounces
Boric acid crystals	1 ounce
Potassium alum	2 ounces

Add enough cold water to make one gallon.

This formula is used full-strength for films and plates and will fix about one hundred 8″ x 10″ films or their equivalent. When the films require more than twenty minutes to clear in this fixing bath, it is an indication that the solution is becoming weak, and it should be discarded and replaced with a fresh solution.

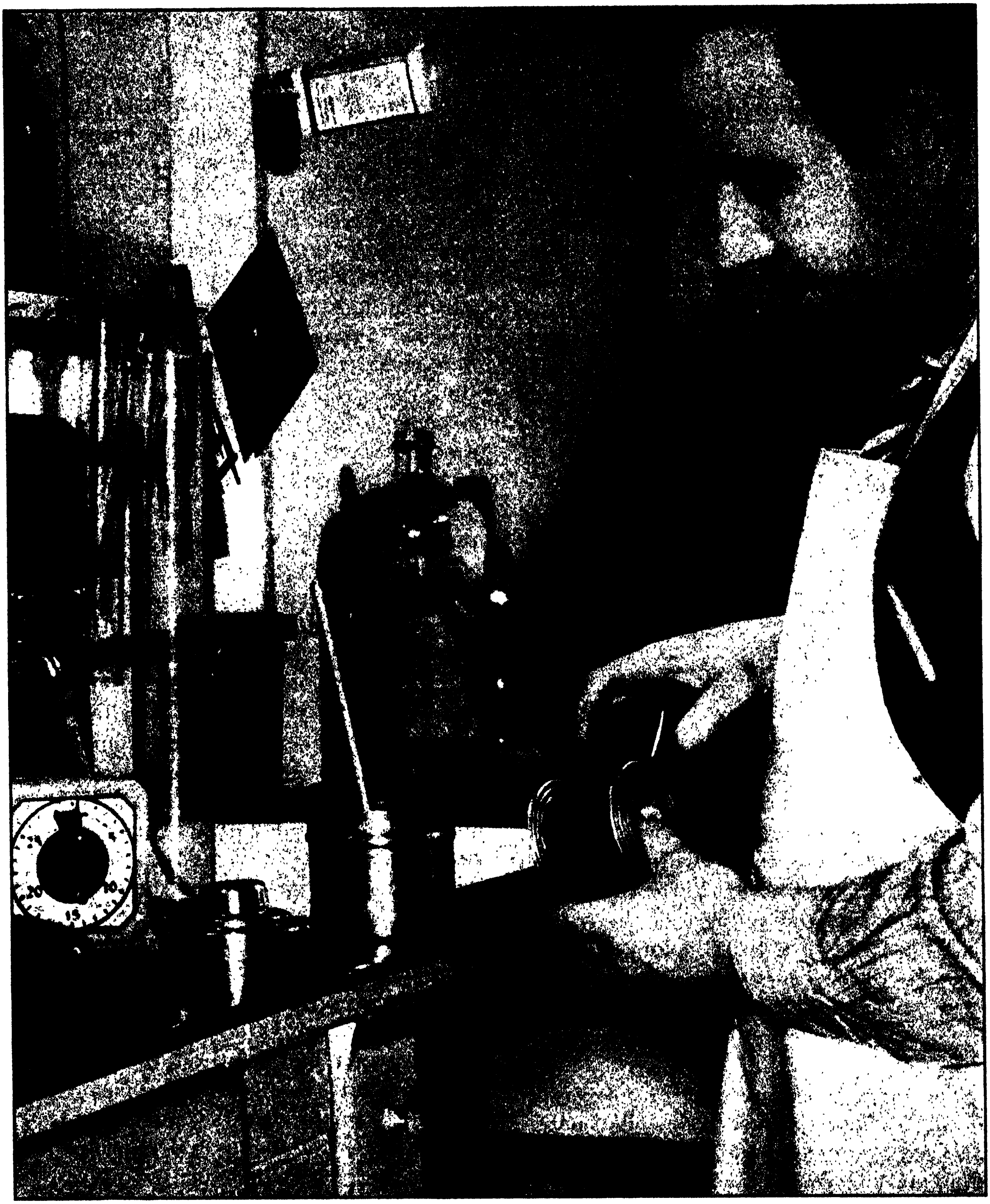
Although the complete steps have been given for development with the use of trays, many amateurs prefer tank development for films and plates because of the convenience and efficiency. Many of the newer amateur films require development in complete darkness, and for this reason a tank is a handy and practical developing device. There are numerous tanks available for amateur use ranging in price from $1.25 to $10. A good tank with an adjustable spool may be purchased for less than $2. These adjustable tanks will handle roll films from 35 mm to 116 sizes. One of the most important advantages of the tank is that films sensitive to all colors and with very high-speed emulsions may be developed by the amateur with excellent results and with a minimum of handling of the film.

The tank development process is as follows. The photographer has a roll of popular-sized film such as 120 Super-XX. These films must be processed in complete darkness. The operator first measures out the necessary quantities of developing solution, rinse, and hypo. He then adjusts the film spool in the tank to the proper size. He then takes the empty tank, film spool, and tank cover into the darkroom. It is essential that the room be absolutely dark, for even the smallest amount of daylight or artificial light may ruin the film.

The film is wound from the roll onto the tank spool. This is easily done even in complete darkness. The film on the spool is inserted in the tank and the lightproof cover placed on the tank. See page 150. The tank may now be taken from the dark closet into a lighted room or the darkroom lights may be turned on. Once the film is loaded in the tank the complete developing process may be done in full light. The developing tanks are constructed so that solutions may be poured into and from the tank without admitting any light. The developer at the proper temperature is poured into the tank and allowed to remain for the required time. The developer is then poured out and the rinse poured in and allowed to remain a few seconds and then poured into the sink. The hypo or fixer is then poured in and allowed to remain from ten to fifteen minutes. At the end of fifteen minutes the cover may be taken from the tank and the film removed for examination. If it is thoroughly cleared of all the milky-appearing emulsion, the film is ready to be washed. The hypo is removed from the tank. The tank without its cover and with the film in it on the spool may be set under the cold-water faucet. The water is allowed to run into the tank for about thirty minutes to remove all traces of the chemical. The film may then be taken from the spool and the excess water removed with a clean, soft, damp chamois or with a cellulose sponge. The film is then hung up to dry. When dry, it is ready for printing or enlarging.

ENLARGING

One of the most interesting phases of photograph finishing and processing is the



LOADING THE SPOOL FOR TANK DEVELOPMENT MUST BE DONE IN ABSOLUTE DARKNESS enlargement of your negatives. The enlarger offers many additional possibilities in printing the negatives. In contact printing the negative must be printed as it is. If the negative happens to have light or underexposed sections, there is little that can be done to correct this in contact printing. This same negative may be placed in the enlarger and the section *dodged* during the projection so as to produce a nearly perfect print. Dodging is the process of passing the hand between the lens of the enlarger and the paper so as to momentarily cast a shadow on the paper and cause the shaded part of the paper to receive less exposure. With this method of dodging the operator may shade light portions of the projected print to bring out and properly expose the more dense sections of the negative.

The enlarger makes it possible to enlarge portions of a negative as well as enlarging the entire negative. Using part of the negative makes it possible for the photographer to make a portrait of one member of a group picture by *masking* off all parts of the negative except the one showing the individual whose portrait is to be made. There are special preparations available from photographic supply houses that may be used for blocking out sections of negatives by brushing the liquid over the undesired portions. You will generally find that you can cut an opening in a sheet of black paper that will permit the portion of the negative desired to be projected and block out the undesired portions.

Detail and depth in negatives are brought out in enlarged pictures that would not be noticed in a contact print. Enlarging small negatives makes them more desirable for publication purposes. Newspapers and magazines prefer pictures of 5″ x 7″ size or larger. The standard for newspapers is an 8″ x 10″ print even though the final picture is smaller.

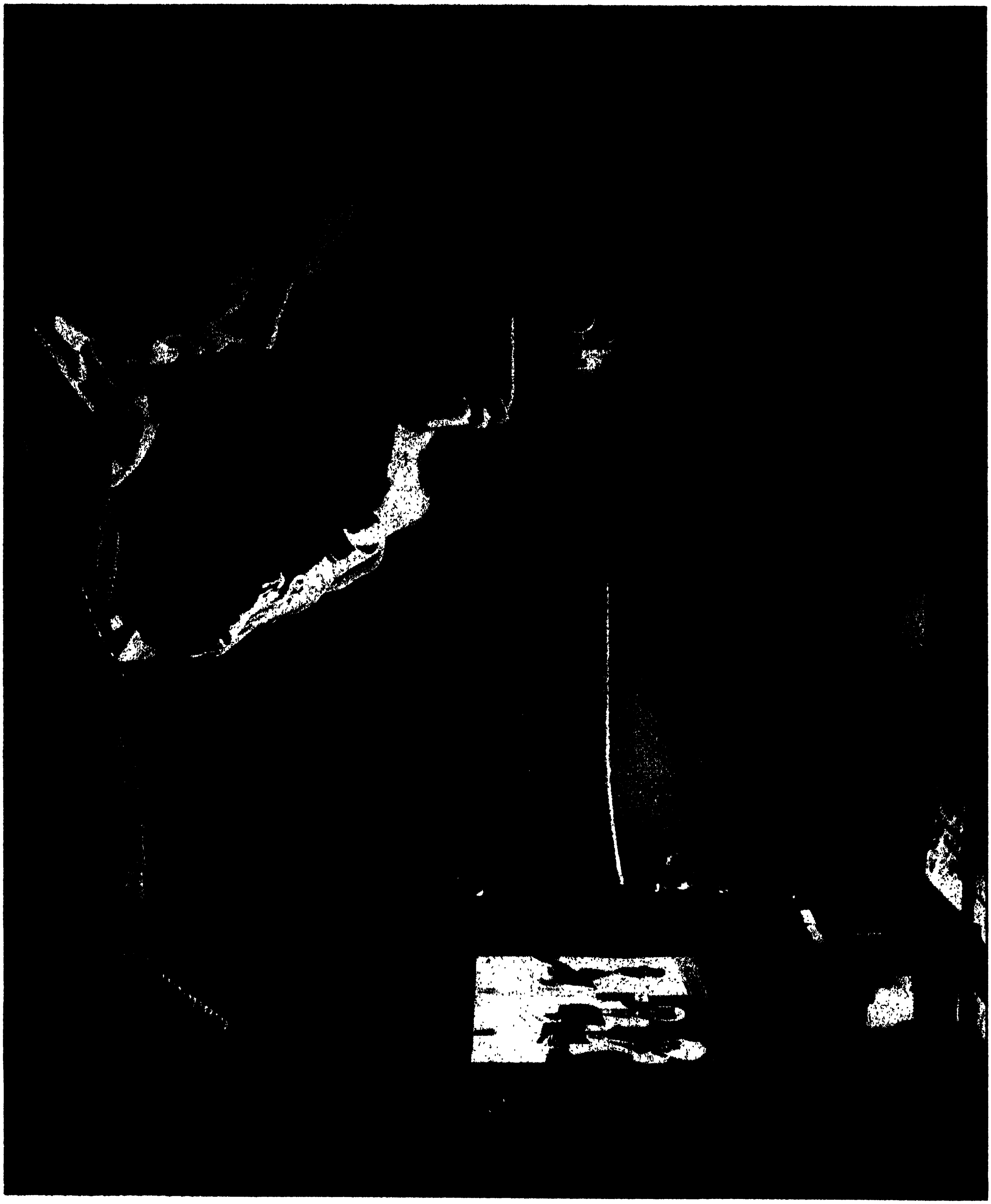
PHOTOMELANGE AND PHOTOMONTAGE

Recently one hears a great deal about special processes such as *photomelange* and *photomontage*. These two processes have to do with blending a number of pictures together to make one large composite picture depicting a number of subjects.

There are several ways in which photomontages may be made. One process is to use a mask before the camera lens so that the photographer exposes only a small portion of the negative at one time. By using a camera with a focusing ground glass on the back, the photographer may mark off each section of the negative that has been exposed. After making half a dozen exposures, the plate is developed and when it is printed the resulting picture contains a number of subjects blended together to make a single picture that tells a story. For example, it may be that the photographer wishes to tell the story of some steel product. This may be done in photomontage by including in one picture a scene from the mine, the blast furnaces, the rolling mill, machine shop, and perhaps the finished steel product in the center of the montage.

Another method of making a composite picture is to take separate pictures of each of the subjects to be included in the completed picture. In photomelange the separate pictures are finished in the usual manner and then cut and fitted together to form a pleasing arrangement. The pasted montage is then rephotographed to produce a negative from which any number of prints may be made.

A convenient method of making montages for the amateur is to make a flat mask large enough to cover the paper on which the montage is to be printed. The mask is then cut in a jigsaw pattern by using a sharp knife to insure clean cut lines. The mask should not have too many parts; six or seven segments are generally enough. A



MAKING AN ENLARGEMENT

small tab of Scotch tape is attached to each segment of the mask so that the segment may be individually lifted to allow the section of paper beneath to be exposed. If you wish to make a montage, select one negative for each segment of the mask. It is wise to know the exposure time for each negative before you attempt to project them onto the montage. If you know how long to project each negative, you will achieve a better and more even montage.

When the negatives have been selected, place the first one in the enlarger, place the sensitized paper under the mask, remove the first section of the mask, and project the image for the proper time. Replace the segment and mark it on the back with a pencil so that you do not by mistake expose it a second time. The second negative is then placed in the enlarger and the next section of paper exposed. This procedure is continued until the montage is completed. The print is then developed and fixed in the usual manner.

PICTURES UNDER ARTIFICIAL LIGHT

New types of fast amateur film now make snapshots with artificial light practical for the amateur. The necessary equipment for night pictures is a kodak or box camera, a roll of fast film such as Eastman Super-XX or Agfa Superpan Press and at least two No. 2 Photoflood lights in reflectors. A rather sure arrangement for lighting is given on page 154. A back light may be used if you wish. The advantage of back lighting is the elimination of heavy shadow toward the back of the picture and the addition of depth to the scene being photographed. The back light may be placed far enough to the side of the subject so as not to show in the picture or it may be placed behind some article of furniture. With the taking of a few indoor and night pictures, you will find that your camera may be used day or night with equal effectiveness. The amateur who becomes an expert is the one who makes mistakes, recognizes them, and profits by his experience to avoid those mistakes in the future.

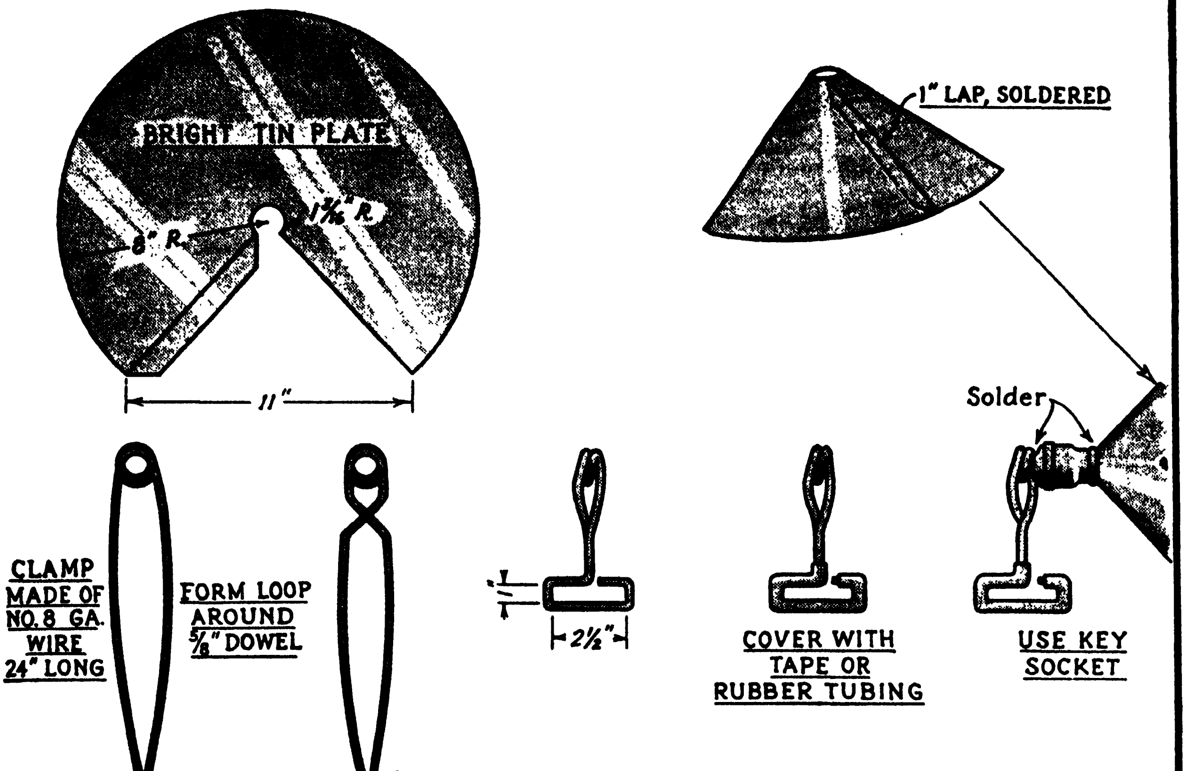
Another method of night photography is to use Photoflash lamps. The amateur will find these a little more expensive to use than Photofloods, since the flash lamps may be used only once. For the amateur these flash bulbs come in two convenient sizes, 11A and 21. The 11A bulb is the smaller of the two and is adequate for pictures in the home or in average-sized rooms. It costs about thirteen cents. The 21 bulb is a larger lamp giving more light for larger scenes and costs about fifteen cents. The flash bulb offers the photographer a portable source of light under conditions where the use of Photoflood bulbs would not be practical.

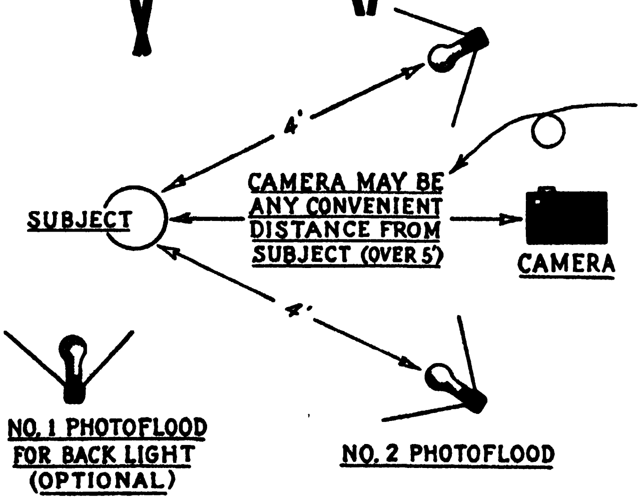
The flash equipment used by the amateur consists of a flashlight-battery case holding two flashlight cells and fitted with a socket and a reflector that permit screwing in a flash bulb. These flash *guns* cost about $1. When taking flash pictures, place the camera on a surface where the shutter may be opened and closed without moving the camera. A tripod is the best support and if many time or inside pictures are taken the amateur will find this a valuable addition to his equipment.

The camera is set to *take* the scene with the shutter set at either *B* or *T*. The release is pressed with the left hand while the flash gun is held in the right hand in position to illuminate the subject. As the shutter snaps open, the flash-gun button is pressed to shoot the bulb. The release is then immediately pressed again to close the shutter. The process is open the shutter, flash the bulb, and close the shutter.

Newspaper men use a mechanical device

A PHOTOFLOOD REFLECTOR


BRIGHT TIN PLATE
8" R.
1 7/16" R.
11"
1" LAP, SOLDERED
Solder
CLAMP MADE OF NO. 8 GA. WIRE 24" LONG
FORM LOOP AROUND 5/8" DOWEL
1/2"
2 1/2"
COVER WITH TAPE OR RUBBER TUBING
USE KEY SOCKET


4'
SUBJECT
CAMERA MAY BE ANY CONVENIENT DISTANCE FROM SUBJECT (OVER 5')
CAMERA
4'
NO. 1 PHOTOFLOOD FOR BACK LIGHT (OPTIONAL)
NO. 2 PHOTOFLOOD

SET-UP FOR INSIDE SNAPSHOTS USING BOX CAMERA OR A BROWNIE

FOR CAMERAS HAVING FASTER LENSES AND MULTIPLE SPEED SHUTTERS, USE FOLLOWING TABLE:

FOR EASTMAN SUPER-XX FILM AND AGFA SUPERPAN PRESS							
DISTANCE FROM TWO NO. 2 LAMPS TO SUBJECT	6'	7'	8'	9'	10'	12'	14'
SHUTTER SPEED	$\frac{1}{25}$	$\frac{1}{50}$	$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$
LENS OPENING "F" NUMBERS	f11	f7.7	f8	f7.7	f6.3	f5.6	f4.5

called a *synchronizer* so that pictures of moving objects or people may be snapped at fast shutter speeds. The synchronizers make it possible to shoot action pictures at speeds ranging from $\frac{1}{50}$ to $\frac{1}{1000}$ of a second or better. Their cost makes synchronizers impractical for the beginner.

LIGHT METERS

Exposure meters and calculators furnish the photographer with measuring devices for determining the amount of light available for making a picture. Careful use of the exposure meter permits the advanced amateur to make evenly and uniformly exposed negatives. An exposure meter is unnecessary for the owner of a camera that does not have variable shutter speeds and an adjustable diaphragm. One of the widest uses of exposure meters is in the making of amateur moving pictures.

Exposure devices are of three types: photoelectric, extinction, and calculator charts.

The *photoelectric meter* is the most accurate and convenient to use. These meters are equipped with a light-sensitive cell which converts light into electrical energy. The electrical energy operates a very sensitive galvanometer which indicates the amount of light by a movable hand and a dial. The stronger the light, the higher the number shown on the dial. The photographer knows the emulsion speed of the film he is using and the intensity of the light as indicated by the meter. By matching these numbers on the dials of the exposure meter, a reading is given showing shutter speed and diaphragm opening needed to give a correctly exposed negative.

Photoelectric exposure meters range in price from $6.50 to $25.

Extinction meters are those which measure light intensity by looking through a strip of smoked or fogged glass with numbers on it. The lower numbers are printed on the portion of the glass that is practically transparent. The strip is more heavily smoked until it reaches a density that makes the higher numbers visible only in very intense light. This strip of glass is contained in a small oval tube or box so that it may be held to the eye and the light on the scene being photographed observed through it. If the light present is bright, you will be able to see nearly all the numbers or, perhaps, all of them. Use the largest visible number. Match the number with the film-speed number on the dial of the meter and obtain a direct reading showing shutter speed and diaphragm opening. These meters are satisfactory for amateur use and may be purchased at prices ranging from $1.50 to $3.

The simplest and easiest-to-use exposure guides are of the *chart* and *slide-rule* type. Although this calculator is by no means accurate, it is far better than the guesswork usually used by the amateur in taking pictures. These exposure guides are operated by judging the scene and then rotating or sliding a section of the chart to a position where the film speed corresponds to the general light conditions you have estimated. The chart then gives a reading for shutter speed and diaphragm opening. These calculators range in price up to $3.

MOVING PICTURES

Taking moving pictures opens a world of opportunity and pleasure for the amateur photographer. Modern production methods of manufacture now bring 8 and 16 mm cameras and projectors to the amateur for as little as $35. An excellent camera and projector may be purchased for $100, which is no more than the cost of a good still camera.

The development of film emulsions has greatly widened the scope and use of the amateur movie camera. So satisfactory has been the progress made in the development of color-sensitive emulsions that the amateur may now take pictures in full color with Eastman Kodachrome with as little experience as is necessary to produce good pictures in black and white. Increase in emulsion speeds makes it easy to take movies at night with Photoflood lights. Four floodlights like the ones shown on page 154 are adequate for making color motion pictures indoors at night using Type A Kodachrome on any camera equipped with a lens having a speed of F 3.5 or faster.

There are two types of Kodachrome available for amateur use. Type A Kodachrome is intended for use only under artificial light while regular Kodachrome is intended for use in natural light. Filters are available for use with Type A Kodachrome that permit its use outdoors with excellent results.

Color film will give perfect color if properly exposed. Poor exposure will affect the color of the finished pictures. Films that are overexposed bleach out while those underexposed are too dark and do not register good color. For this reason it is advisable that the photographer rely on a light meter for regulating his exposures. All processing of movie film is included in the purchase price of the film. After taking a roll of color or black and white film, you mail the film to the manufacturer and it is returned in a few days ready for projection.

The amateur can at small cost take and edit his own moving pictures to produce entertaining and pleasing effects.

PHOTOGRAPHY FOR A LIVELIHOOD

Industry uses many photographers. You are familiar with the neighborhood photographer who takes pictures of a person, a family, or a wedding party. These people are known as portrait photographers. Often several skilled workers are employed in producing the final picture. If you go to a studio to have a picture taken, you may come in contact with only the one who actually snaps the camera shutter. There are others who do special developing and finishing work in the laboratory or darkroom. When the picture has been developed, it generally needs *retouching*, which means blending and softening some parts of the negative so that the final print will be pleasing to the customer.

A third person may take the retouched negative and make prints from it. A fourth individual, usually a girl or young man who is learning the trade, trims and mounts the print. In a small shop one man may do all these operations himself.

Many times the men who run these small studios are called into private homes to take pictures. They perform such other services as photographing a home that is to be sold so that the real-estate office can show the picture to interested persons. In small towns taking pictures for the local papers of church weddings, parties, and industrial or factory scenes is often the local photographer's job.

Larger newspapers employ regular photographers. They have two types. One man roves the streets taking pictures of accidents, sports, and interesting news events. A large Chicago newspaper employs about twenty-five such men and they are paid from $45 to $75 a week. The other photographer is the man who works in the engraving rooms taking pictures of sketches, drawings, and objects that are to be represented in the paper. These are made into printing plates for the presses.

Some of the larger business firms employ a photographer to take pictures of their products for advertising purposes and to be used for sales promotion.

Both the Army and the Navy find that the photographer is a necessary part of their organizations. Special cameras have been constructed so that clear, sharp pictures can be taken at very high altitudes.

Some of the necessary qualifications for photographers are steady nerves, artistic ability, and some understanding of chemistry. Some of their work is risky and at times they must take extreme chances to secure pictures. As a rule they are well paid—usually for their special ability to produce unique results.

SUMMARY

A darkroom is an essential for both the development and printing of pictures. There are two methods that may be used in developing—tray and tank. The use of trays enables the amateur to observe the gradual formation of the outlines on the negative as the latest image is developed by the chemical reactions. In tank development the more light-sensitive films may be handled and a darkroom is needed only for loading and unloading films. Care must be taken in developing to have the water at the correct temperature and the chemicals exactly measured in order to get the best results. Contact printing of films is possible by means of an easily made printing box. Exposure meters make possible more accurate and better negatives by giving exact and definite information as to the length of exposure needed under the particular lighting conditions. The use of artificial lighting, color film, and the making of composite pictures all offer interesting possibilities for the amateur photographer.

QUESTIONS

1. How should the trays be arranged in the darkroom for developing and what goes in each tray?
2. How long should an average film be passed through the developer for good results?
3. What does the hypo do to a film in development?
4. What is meant by a *mask* on a printing box?
5. Why keep a jug of water in the darkroom?
6. Show by a diagram the arrangement of materials for contact printing in a darkroom.
7. How are the negative and printing paper placed in the printing box?
8. How can you tell on what side of the film the emulsion is placed?
9. Which is the emulsion side of the printing paper?
10. What is a good method for drying prints?
11. Why do many prefer tank development to tray development?
12. What does a photographer mean when he says he will *blow up* a picture?
13. What is a photomontage?
14. When are Photoflash and Photoflood lights used?
15. What is the value of photography to industry?

TOPICS FOR DISCUSSION

1. Developing a Roll Film.
2. Making a Contact Print.
3. Kinds of Printing Papers.
4. Ferrotype Plates for Photography.
5. Developing a Film in a Tank.
6. The Advantages of Enlarging Pictures.
7. Why the Wise Amateur Uses a Light Meter.
8. The Importance of Washing Prints.
9. Why I'd Like to Be a Commercial Photographer.
10. How to Build a Darkroom.

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